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United States Department of Energy

LONG-TERM SURVEILLANCE PLAN FOR THE BODO CANYON DISPOSAL SITE, DURANGO, COLORADO

September 1996

RECORD

Uranium Mill Tailings Remedial Action Project

DOE/AL/62350-77
REV. 2

LONG-TERM SURVEILLANCE PLAN FOR THE BODO CANYON DISPOSAL SITE DURANGO, COLORADO

September 1996

Prepared for
U.S. Department of Energy
Environmental Restoration Division
UMTRA Project Team
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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

TABLE OF CONTENTS (Concluded)

LIST OF FIGURES

LIST OF PLATES

LIST OF TABLES

LIST OF ACRONYMS

Acronym	Definition
BMT	boundary monument
CDOW	Colorado Division of Wildlife
CDPHE	Colorado Department of Public Health and Environment
DOE	U.S. Department of Energy
DQO	data quality objective
EPA	U.S. Environmental Protection Agency
ES&H	environment, safety and health
GJPO	Grand Junction Projects Office
LTSP	long-term surveillance plan
MCL	maximum concentration limit
MSL	mean sea level
NRC	U.S. Nuclear Regulatory Commission
NWS	National Weather Service
PMP	probable maximum precipitation
POC	point of compliance
QA	quality assurance
QC	quality control
RAC	remedial action contractor
RAP	remedial action plan
RRM	residual radioactive material
SM	survey monument
SMK	site marker
SOP	standard operating procedure
SOW	statement of work
TAC	Technical Assistance Contractor
UMTRA	Uranium Mill Tailings Remedial Action
UMTRCA	Uranium Mill Tailings Radiation Control Act
UPDCC	UMTRA Project Document Control Center
USGS	U.S. Geological Survey
VCA	Vanadium Corporation of America

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TEMPORARY LIST OF REFERENCES AND ACRONYMS – GENERATED ON 11/02/95

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1.0 INTRODUCTION

This long-term surveillance plan (LTSP) for the Uranium Mill Tailings Remedial Action (UMTRA) Project Bodo Canyon disposal site at Durango, Colorado, describes the surveillance activities for the disposal site. The U.S. Department of Energy (DOE) will carry out these activities to ensure that the disposal cell continues to function as designed. This LTSP was prepared as a requirement for DOE acceptance under the U.S. Nuclear Regulatory Commission (NRC) general license for custody and long-term care of residual radioactive materials (RRM) from processing uranium ore. This LTSP documents that the land and interests are owned by the United States and details how long-term care of the disposal site will be carried out. It is based on the DOE's *Guidance for Implementing the UMTRA Project Long-term Surveillance Program* (DOE, 1992a).

1.1 BACKGROUND

Title I of the *Uranium Mill Tailings Radiation Control Act* (UMTRCA) of 1978 (42 USC §7901 *et seq.*) authorized the DOE to perform remedial action at 24 inactive uranium processing sites to reduce potential adverse health effects to the public from unstabilized RRM in and around the uranium mill tailings. The Durango, Colorado, uranium processing site in La Plata County, Colorado, was one of these 24 sites. The DOE, NRC, and the state of Colorado entered into a cooperative agreement under the UMTRCA, establishing the terms and conditions of the remedial action (DOE Cooperative Agreement No. DE-FC04-81AL16257, 19 October 1981) (DOE, 1981). Concurrence from the NRC on the remedial action plan was received 4 November 1994 (Attachment 1).

1.2 LICENSING PROCESS

The NRC has developed regulations in 10 CFR §40.27 for issuing a general license for the long-term care of UMTRA Project (Title 1) disposal sites, including the Bodo Canyon disposal site. The license is available only to the DOE (or any successor federal agency designated by the President of the United States) and has no termination date. The purpose of this general license is to ensure that the UMTRA Project disposal sites will be cared for in a manner that protects the public health and safety and the environment after the NRC and DOE concur that the remedial action is complete (i.e., acceptance of the Bodo Canyon Completion Report and Certification Summary) at that site and formally accepts the site-specific LTSP that meets the requirements of 10 CFR §40.27. The Bodo Canyon Completion Report documents the disposal site as-built conditions. The DOE prepares a Certification Summary certifying satisfaction of approved RAP provisions and compliance with EPA standards.

When the general license becomes effective after approval of the LTSP, responsibility for the long-term surveillance program will be transferred to the DOE Grand Junction Projects Office (GJPO), Grand Junction, Colorado. The programmatic transfer will occur within 30 days of NRC notification that the license is in effect. The DOE remains the responsible federal agency unless a successor agency is designated by the President of the United States.

Acquisition

The land on which the disposal site is located was acquired by the Colorado Department of Public Health and Environment (CDPHE). The site consists of two parcels, Tracts 101 and 102. The parcels were deeded to CDPHE on 4 August 1987, and 6 November 1992, respectively. On 20 October 1993, the state of Colorado forwarded draft deeds and supporting documentation for the transfer of the site to the federal government, pursuant to 42 USC §7914(f). The U.S. Army Corps of Engineers, Omaha Office, must provide real estate support services to the DOE and is responsible for effecting the title transfer.

For additional information, see Attachment 2, which provides the legal description for the disposal site, Tracts 101 and 102.

1.3 LONG-TERM SURVEILLANCE PLAN

This document describes the long-term surveillance activities that will be conducted at the Bodo Canyon disposal site to ensure that it continues to perform as designed. This plan is based on the DOE's *Guidance for Implementing the UMTRA Project Long-term Surveillance Program* (DOE, 1992a).

This LTSP meets the requirements of 10 CFR §40.27 by addressing the following:

- Site description and ownership.
- Description of final site conditions.
- Site inspection procedures and personnel.
- Custodial maintenance and corrective action programs.
- Record keeping and reporting.
- Quality assurance (QA).
- Emergency response.

2.0 SITE FINAL CONDITIONS

2.1 PROCESSING AND DISPOSAL SITE HISTORY

The Durango uranium processing mill was located southwest of the Durango town limits, on the west bank of the Animas River (Figure 2.1), located near the south end of a mill/tailings site operated from 1880 to 1930. In 1942, U.S. Vanadium Corporation leased the property and constructed a uranium processing mill on the site. This mill operated until 1946, when the mill was shut down. In 1949, Vanadium Corporation of America (VCA) leased and subsequently purchased the processing site. The VCA operated the mill and sold uranium to the U.S. Atomic Energy Commission until March 1963, when the mill shut down permanently. Ranchers Exploration and Development Corporation purchased the mill in 1977. Hecla Mining Company acquired Ranchers Exploration and Development Corporation in July 1984. The Durango mill produced an estimated 1.2 million cubic yards (yd^3) (92,000 million cubic meters [m^3]) of tailings. Other surface contamination included vicinity property material, contaminated earth, mill debris, slag, and windblown material. In March 1987, the DOE initiated remedial action to relocate the approximately 2.5 million yd^3 (1,900,000 m^3) of tailings piles and contaminated soils from the processing site to the Bodo Canyon disposal site. Relocation was completed in the fall of 1990.

Prior to receiving tailings and contaminated soils from the processing site, the Bodo Canyon disposal site was used as pastureland and was managed by the U.S. Department of the Interior, Bureau of Land Management. No mining, milling, or other industrial activities occurred in the valley before the disposal cell was established.

2.2 DESCRIPTION AND LOCATION OF THE DISPOSAL SITE AREA

The disposal site comprises approximately 120.6 acres (ac) (48.8 hectares [ha]) in La Plata County, Colorado, approximately 3.5 road miles (mi) (5.6 kilometers [km]) southwest of Durango, Colorado (Figure 2.1), in the eastern half of Section 36, Township 35 North, Range 10 West, and the western half of Section 31, Township 34 1/2 North, Range 9 West, New Mexico Principal Meridian (Figure 2.2) (DOE, 1993b).

The disposal site is in the upper west end of Bodo Canyon, an ephemeral drainage basin of about 4.5 square miles (mi^2) (11.6 square kilometers [km^2]) bordered by Smelter Mountain on the north, Carbon Mountain on the south, and the Animas River on the east (Figure 2.2).

The disposal site lies at an elevation of approximately 7100 feet (ft) (2200 meters [m]) above mean sea level (MSL). Area elevations range from 7725 ft (2355 m) at the top of Smelter Mountain (approximately 0.85 mi [1.4 km] from the site) to about 6600 ft (2000 m) at the mouth of Bodo Canyon. The Cliff House Sandstone of the Mesaverde Group (Cretaceous) underlies the site;

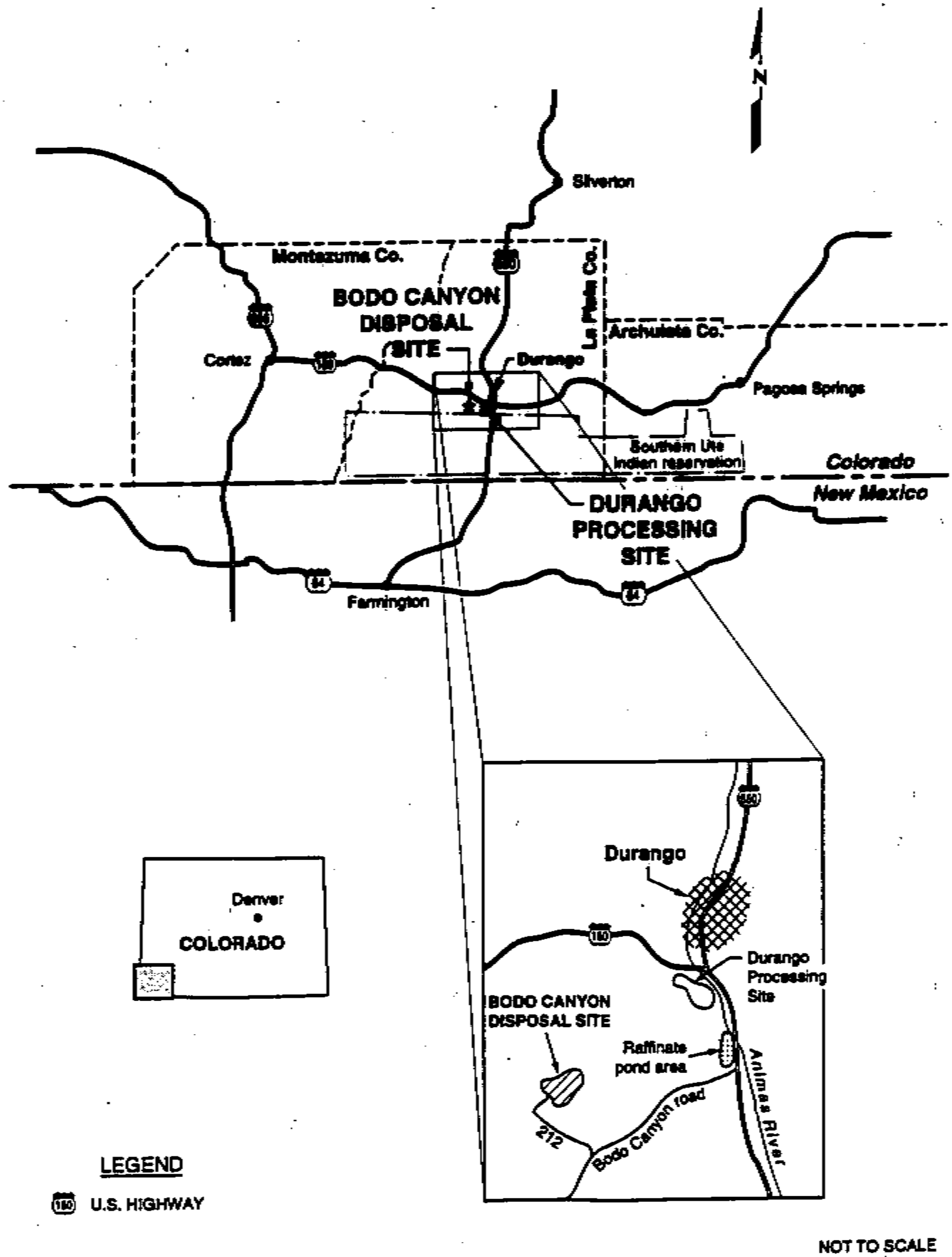


FIGURE 2.1
LOCATION OF BODO CANYON DISPOSAL SITE
LA PLATA COUNTY, COLORADO

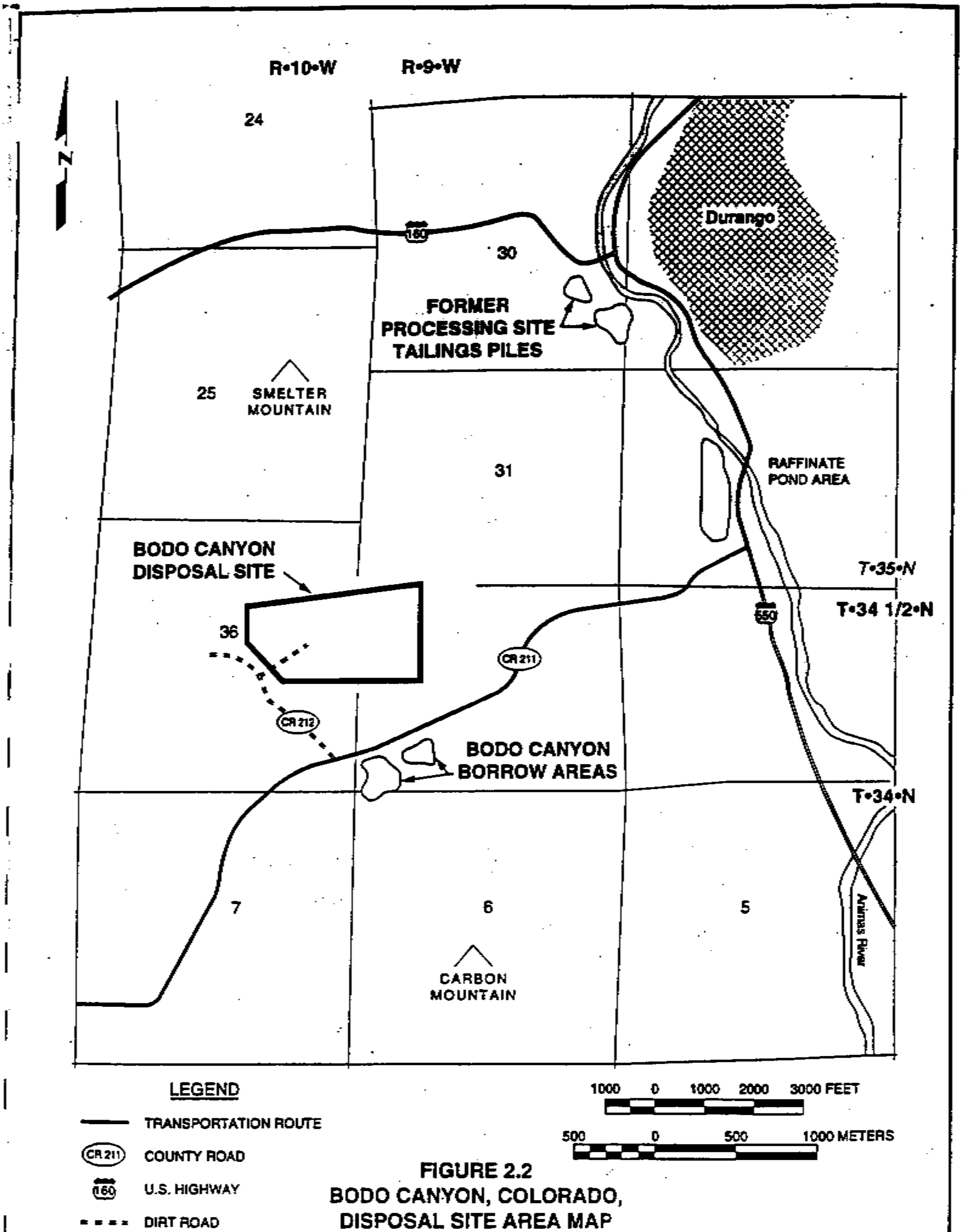


FIGURE 2.2
BODO CANYON, COLORADO, DISPOSAL SITE AREA MAP

MAC: SITE/DUR/LTSP/SITEMAP

sandstone units are exposed in the hillside at the east end of the site. The site is near the north edge of the San Juan Basin. Rock formations in the area dip south toward the center of the basin. Grasses and sagebrush vegetate the bottomlands of Bodo Canyon (DOE, 1993b).

Figure 2.2 is a map of the Durango, Colorado, area. The disposal site can be located using the following directions:

1. Where U.S. Highway 160 joins U.S. Highway 550 (US-550/160) just west of downtown Durango, proceed south on US-550/160.

2. Drive south on US-550/160, turn west (right) on County Road 211 (CR 211); CR 211 becomes a dirt road.

3. Remain on CR 211, heading southwest.

4. A substation is on the right side of the road. Remain on CR 211.

5. Turn northwest (right) onto CR 212. Proceed northwest.

6. Turn north (right) onto the entrance road.

7. The site entrance gate is at the southwest corner of the site.

2.3 DISPOSAL SITE ACCESS

The supervisory general engineer at the GJPO holds keys to the lock on the disposal site security gate. The other key holders are the DOE Contractor representatives as assigned by DOE and CDPHE (Table 2.1).

2.4 DISPOSAL CELL DESIGN

The disposal cell is constructed partially below existing grade. It covers approximately 60 ac (24 ha), with maximum areal dimensions of 2400 x 1300 ft (730 x 400 m). Figure 2.3 is a plan view of the disposal cell.

The radon barrier thickness was determined to be conservative, based upon radiological characterization of the contaminated materials obtained prior to and during construction. The radon emanation rate from the completed disposal cell meets the EPA standard of 20 picocuries per square meter per second. The tailings were encapsulated with a compacted 2-ft (0.6-m)-thick radon barrier layer of uncontaminated silty clay and clay materials. On the sideslope, the upper 18 inches (46 centimeters [cm]) of the radon barrier were amended with 7 percent bentonite to maintain a consistent radon barrier thickness on the top and sides of the cell. Additionally, the radon barrier on the topslope was constructed with a bentonite geomembrane (bentonite sandwiched between two geotextiles) on the surface to restrict infiltration into the barrier. The radon

Table 2.1 Bodo Canyon, Colorado, disposal site access key holders

Title and current contract	Telephone	Address
GJPO supervisory general engineer	(970) 248-6006	Grand Junction Projects Office 2597 B 3/4 Road Grand Junction, Colorado 81503
Technical Assistance Contractor UMTRA Project Manager (as of date of publication)	(505) 888-1300	Jacobs Engineering Group Inc. 2155 Louisiana NE Suite 10,000 Albuquerque, New Mexico 87110
Colorado Department of Public Health and Environment	(970) 248-7165	Colorado Department of Public Health and Environment 222 56th Street Room 232 Grand Junction, CO 81501

barrier is further protected by a 6-inch (150-millimeter [mm]) sand filter/drainage layer on the sideslopes and top.

The topslope was completed with a 1.5-ft (0.5-m) biointrusion layer, a 2.5-ft (0.8-m) frost-protection layer, and a 6-inch (150-mm) rock/soil matrix. The matrix has a 1.5 to 2.0 percent grade away from a drainage divide at the center of the cell. In addition to the rock/soil layer, the cell topslope is covered with native grasses. The cover system for the embankment topslope is illustrated in Figures 2.4 and 2.5.

The sideslope was completed with a 6-inch (150-mm) bedding layer, a 1.5-ft (0.5-m) frost-protection layer, another 6-inch (150-mm) bedding layer, and a 1.0-ft (0.3-m) riprap layer. The riprap is keyed along the cell perimeter to prevent headcutting erosion at the cell boundary.

The drainage features of the embankment and general site grading ensure long-term embankment stability as required in 40 CFR §192.02(b). Runoff from the embankment flows to the apron and then to the adjacent natural ground on the northern slope of the cell. All other sideslopes of the cell drain to perimeter catchment ditches that channel the concentrated flows to outfall structures. Ditch No. 1 carries flow from the eastern slope and drains to an outfall structure at the arroyo north of the cell. Ditch No. 2 carries flows from the southern face of the cell and drains to an outfall structure at the escarpment to the east. Ditch No. 3 captures a smaller drainage from the northwestern and western slopes of the cell and a small upland drainage area. It also divides the drainage to the north and southwest. The ditches have sufficient depth and rock protection to carry runoff from the probable maximum precipitation (PMP) event. Significant precipitation events can create velocities capable of moving sediment buildup in the ditches. Flows in the major arroyos north and south of the cell, produced from a PMP event occurring in the upland drainage area, will not impact the toe of the disposal cell.

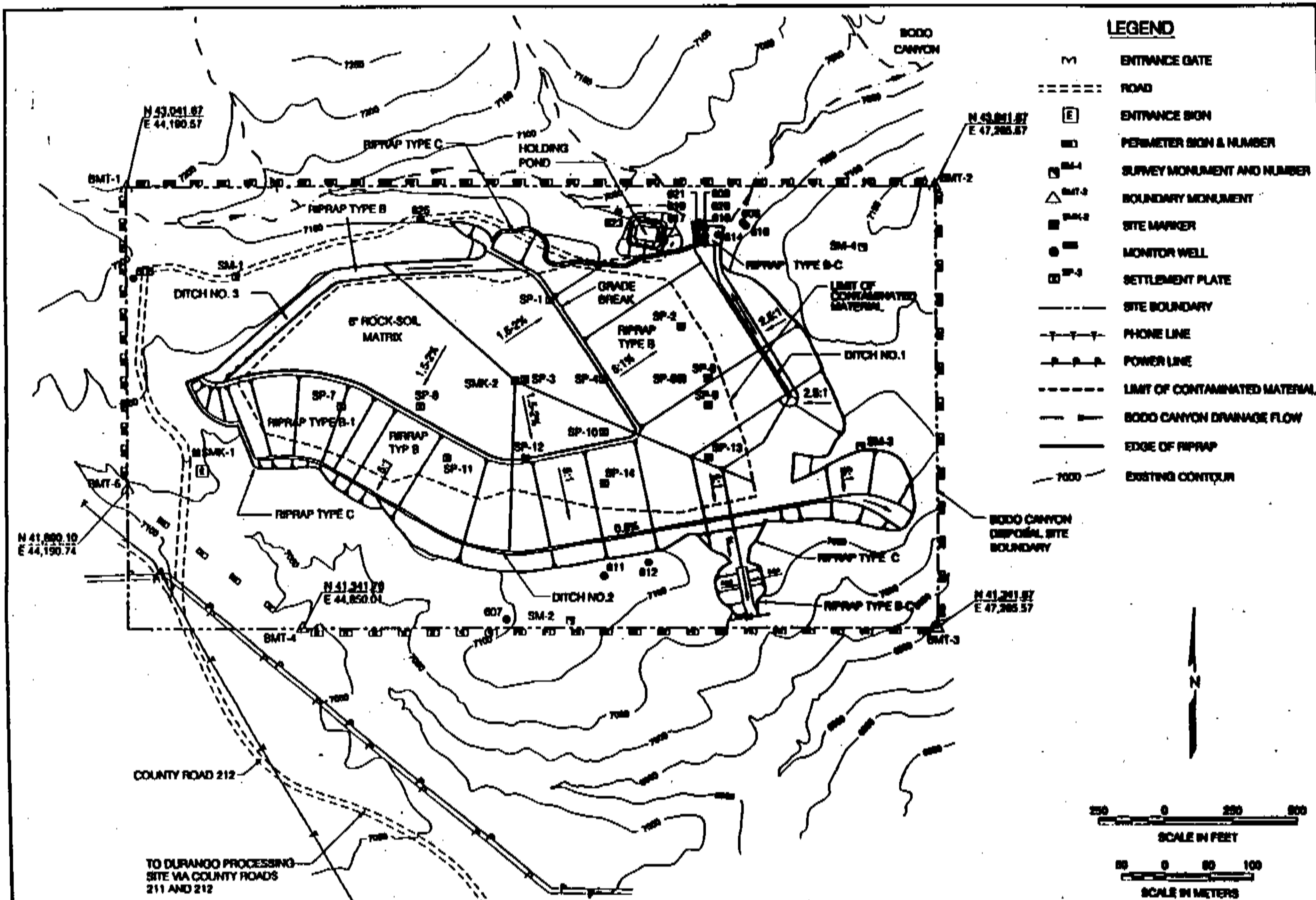


FIGURE 2.3
PLAN VIEW OF BODO CANYON, COLORADO, DISPOSAL CELL

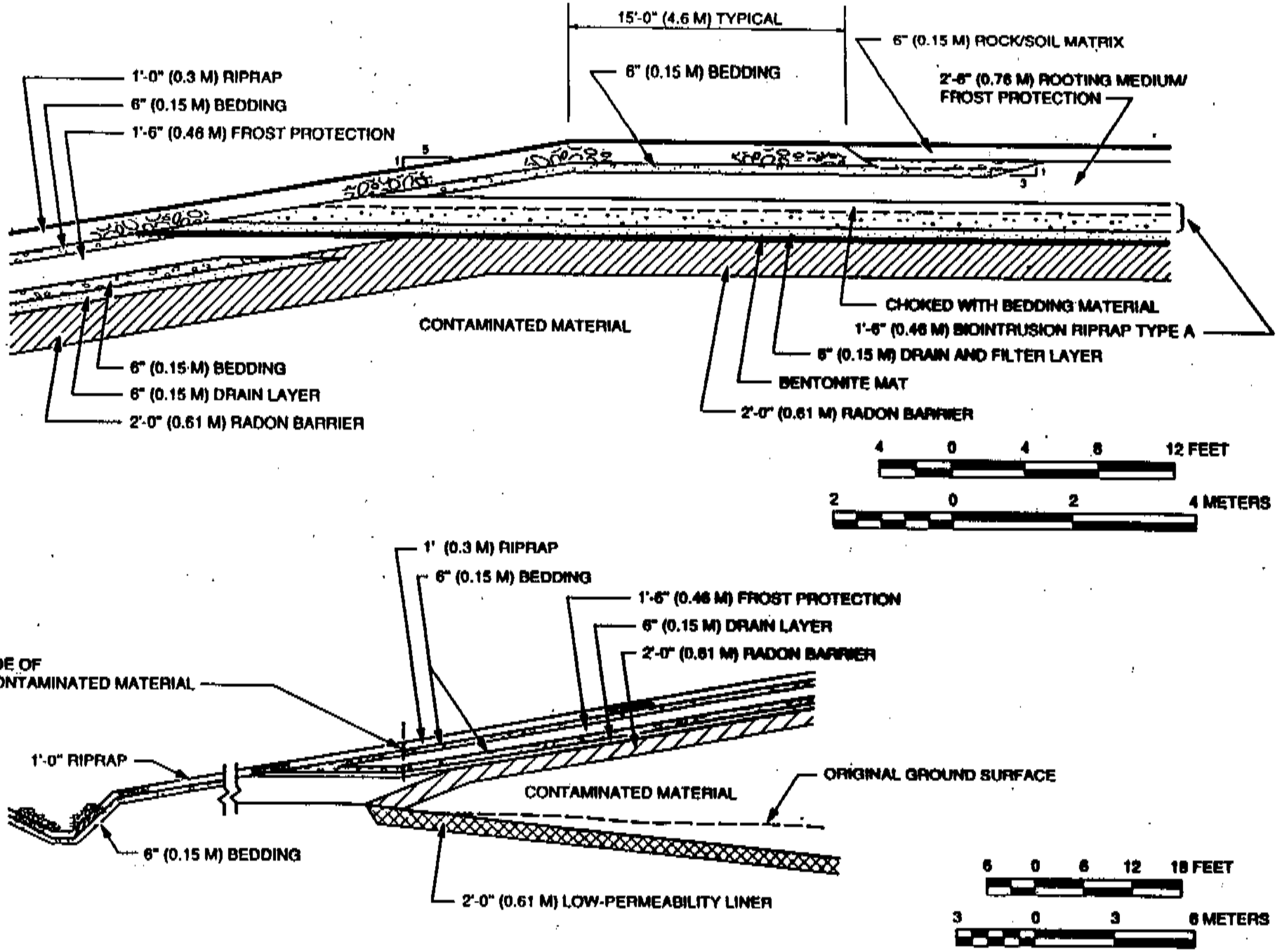


FIGURE 2.4
AS-BUILT CROSS SECTION OF COVER SYSTEM
BODO CANYON, COLORADO, DISPOSAL CELL

MAC: SITE/DUR/LTSP/DISPSITE

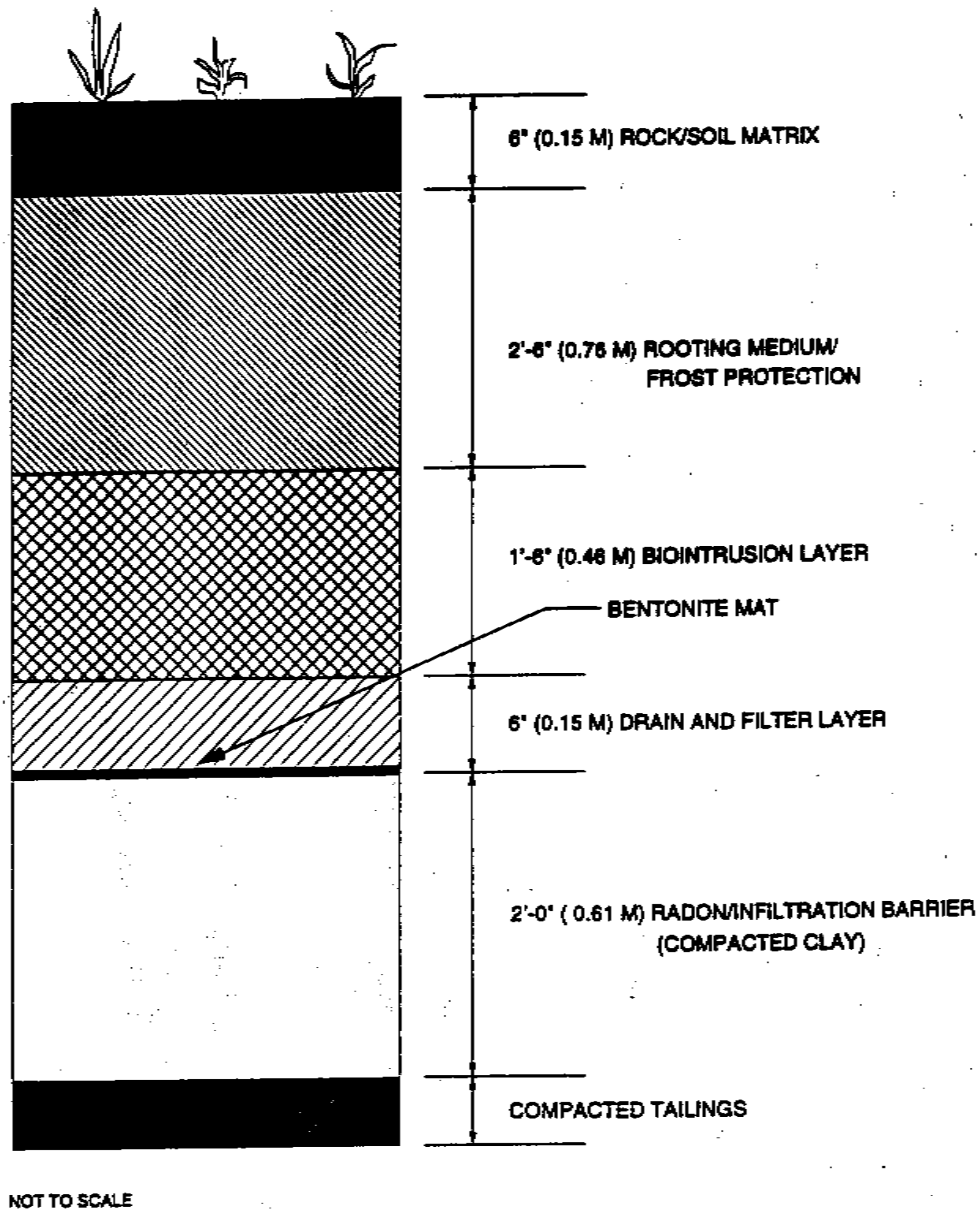


FIGURE 2.5
TOPSLOPE COVER SYSTEM
BODO CANYON, COLORADO, DISPOSAL SITE

TOPCOVER.DRW

PATH: K/FL3.01\DUR

The following major design features will mitigate potential ground water contamination at the disposal site:

- A low-permeability liner on the sides and below the contaminated tailings (Figure 2.4).
- A compacted radon/infiltration clay barrier above the tailings material (Figure 2.5).
- A high-conductivity sand drain/filter layer placed on the top of the radon barrier (Figure 2.5).

The low-permeability liner placed underneath the tailings material is composed of natural, recompacted, silty clay and clay soils. These soils have high neutralization, adsorption, and ion exchange potential and thus provide a high attenuating capacity to restrict downward contaminant migration through the barrier.

During disposal cell construction, a seepage required the construction of a toe drain and holding pond that will be in service for a relatively short period of time. The seepage water collected in the pond is treated periodically and discharged in accordance with the CDPHE discharge permit. Attachment 3 describes the seepage that developed and the criteria and plan for final closure and decommissioning of the toe drain and holding pond. Because the toe drain and pond are temporary, no long-term surveillance of these features is described in Attachment 3 of this document. However, in accordance with the CDPHE permit, the toe drain and pond are inspected monthly. Attachment 4 contains a copy of the Bodo Canyon Toe Drain Pond Discharge Permit Management Plan.

3.0 SITE DRAWINGS AND PHOTOGRAPHS

At the completion of remedial action, disposal site as-built conditions were documented with as-built drawings and photographs (MK-F, 1991). This information illustrates baseline conditions for comparison to future disposal site conditions.

A disposal site topographic map was prepared and will become part of the Durango permanent site file. The site inspection map will be updated, as necessary, after each site inspection. The disposal site maps and all drawings and photographs will be archived by the UMTRA Project Document Control Center (UPDCC). The topographic map, disposal site map drawings, and photographs may be further modified by the GJPO, as necessary, and the GJPO will be responsible for maintaining and archiving maps, drawings, and photographs after the Durango permanent site file is transferred to the GJPO.

3.1 DISPOSAL SITE MAP

The Bodo Canyon disposal site map (Plate 1) identifies the following site features:

- Disposal site plus an area of 0 to 650 ft (0 to 200 m) around the site boundary.
- Topographic features.
- Permanent site surveillance features.
- Entrance road and gate/barricade.
- Drainage gully and drainage channels.
- Disposal site boundary.
- Disposal cell.
- Ground water monitoring wells.

Updates to the map will include the year of revision and the revision number.

The Bodo Canyon disposal site map will serve as the base map for site inspections (Section 6.4). A new, separate inspection map will be prepared after each inspection. Each site inspection map will indicate the year and type of inspection.

The Bodo Canyon disposal site base map and site inspection maps will become part of the Durango permanent site file.

3.2 DISPOSAL SITE AS-BUILT DRAWINGS

A set of as-built drawings provided by Morrison-Knudsen Ferguson (MK-F) illustrates the final disposal cell construction and final disposal site conditions. These drawings were used to prepare the disposal site map. They may be used to document changes in physical site conditions or the disposal cell over time and to develop corrective action plans, if required. At licensing, the DOE will transfer one original set of as-built drawings to the GJPO. These drawings will be filed and maintained in the Durango permanent site file at the GJPO.

3.3 SITE BASELINE PHOTOGRAPHS

A photographic record of the final site conditions at the Bodo Canyon disposal site will be included and maintained in the Durango permanent site file. This record consists of a series of aerial and ground photographs that provide a baseline visual record of final site construction and final site conditions to complement the as-built drawings. The post-construction photographs provide an orientation tool for site inspections and a baseline record of surveillance features.

3.4 SITE AERIAL PHOTOGRAPHS

Aerial photographs for the disposal site were taken throughout remedial action activities from 1987 to 1989 and in 1990 and 1991 after surface remedial action was complete. These photographs provide a record of site conditions, enabling inspectors to monitor changes in site conditions (e.g., erosion patterns, vegetation changes, and land use) over time. The photographs are a useful orientation tool for disposal site inspections. The need for new aerial photographs will be evaluated at 5-year intervals, beginning the year the site license becomes effective. Table 3.1 summarizes the specifications for aerial photographs at the Bodo Canyon disposal site. More detailed guidance is provided in Attachment 3 of the *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE, 1992a).

3.5 SITE INSPECTION PHOTOGRAPHS

Photographs will be taken during site inspections to document conditions at the disposal cell and the disposal site; they will be maintained in the Durango permanent site file. These photographs will provide a continuous record to monitor changing conditions over time and to compare with baseline photographs.

Each photograph will be recorded individually on a site inspection photo log (Attachment 5). An appropriate description of the feature photographed, including the azimuth (if necessary), will be entered into the log. Copies of disposal site inspection photographs and the photo log will be included in annual site inspection reports.

When possible, each photograph will include a reference point such as a survey monument or boundary monument, site marker, or monitor well. For large-scale features such as drainage ditches or disposal cell slopes, a north arrow and scale will be included on the developed photographs for reference.

For specific areas in which a photograph is used to monitor change over time, the distance from the feature and the azimuth will be recorded, and all

Table 3.1 Aerial photography specifications for the Bodo Canyon, Colorado, disposal site

Area to be photographed	Final disposal site plus a minimum of 0.25 mi (0.4 km) beyond site boundaries unless site conditions require otherwise.
Products to be delivered	One set of vertical color, infrared stereo contact prints, 9-in (230-mm), scale 1 inch = 200 ft (1 mm = 2.4 m) (representation fraction 1:2400); double weight, glossy, not trimmed. One index map, scale 1 inch = 200 ft (1 mm = 2.4 m); flight lines and frame numbers will be provided. One set of 2 each of low- and high-oblique photographs (and negatives) in natural color, 8- x 10-inch (200- x 250-mm); or 9- x 9-inch (230- x 230-mm) contact prints.
Flight date	To be determined upon the acceptance of this LTSP.
Camera	Precision, 9- x 9-inch (230- x 230-mm) format for vertical photos. A 35-mm (single lens reflex) or larger format camera for oblique photos is acceptable.
Film	Eastman-Kodak Aerochrome Infrared 2443, or its equivalent, for vertical photos. Eastman-Kodak Ektacolor, or its equivalent, for oblique photos.
Filter	Wratten No. 12 or 15 for infrared photos. Skylight filter for color photos.
Flight line coverage	60 percent end overlap; 30 percent average side overlap.
Ground control	Control stations will be second order, Class 1, for horizontal control and third order for vertical control (standard U.S. Geological Survey map accuracy specifications).

subsequent photographs should be taken from the same orientation to provide an accurate picture of changing conditions. The magnetic declination of the compass should be corrected for true north. This information will also be provided on the site inspection checklist and photo log.

Features to be photographed

The following disposal site features should be documented with photographs during every scheduled inspection at the Bodo Canyon disposal site:

- Permanent site surveillance features (Plate 1).
- Entrance road and gate/barricade.
- Drainage gully and drainage channels.
- Disposal cell.
- Ground water monitor wells.
- Holding pond.
- Erosion protection material (riprap).
- Vegetation.
- New or potential problem areas.

4.0 PERMANENT SITE SURVEILLANCE FEATURES

Survey monuments (SM), boundary monuments (BMT), site markers (SMK), and entrance and perimeter signs are the permanent surveillance features at the disposal site. Four survey monument coordinate locations are listed in Table 4.1. Five boundary monuments define the corners of the unfenced perimeter of the disposal site. Eighty-two warning signs are placed around the perimeter of the disposal site.

The construction and emplacement of the site surveillance features, described below, meet the specifications delineated in the DOE's *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE, 1992a).

4.1 SURVEY MONUMENTS

SM-1 is in the northwest quadrant of the site, SM-2 is south of the disposal cell, and SM-3 and SM-4 are to the east (Plate 1). The monuments, Bernsten RT-1 metal markers, were set into the top of a truncated cone of reinforced concrete set in concrete. The design of the survey monuments is shown in Figure 4.1.

4.2 BOUNDARY MONUMENTS

Five Bernsten Federal aluminum survey monuments, Model A-1, were used for the site boundary monuments (BMT-1, BMT-2, BMT-3, BMT-4, and BMT-5). BMT-1, BMT-2, and BMT-3 mark the site's northwest, northeast, and southeast corners (Plate 1). BMT-4 is at the west end of the south boundary, and BMT-5 is at the south end of the west boundary (MK-F, 1991). The design of the boundary monument is shown in Figure 4.2.

4.3 SITE MARKERS

Two unpolished granite site markers (SMK-1 and SMK-2) are within the restricted site boundary. SMK-1 is just inside the entrance gate. SMK-2 is on top of the disposal cell revegetated area. Site markers were constructed with the dimensions shown in Figures 4.3 and 4.4. The markers identify the disposal site, the general location of the disposal cell, the date of closure (3 August 1990), the dry tonnage of RRM (3,460,000 dry tons [3,140,000 tonnes]), and the curies of radioactivity (1400 curies, radium-226) (Figure 4.5).

4.4 ENTRANCE AND PERIMETER SIGNS

The site entrance sign is at the entrance gate (Figure 4.6). In addition to the entrance sign, 82 perimeter signs are located at the site (Figure 4.7). These signs display the international symbol indicating the presence of radioactive materials. They also state that the disposal site is U.S. Government property and forbid trespassing. The entrance sign has the same information as the perimeter signs, plus the name of the site and the name and telephone number

Table 4.1 Locations of monuments and markers, Bodo Canyon, Colorado, disposal site

Symbol	Elevation 12/06/93	Elevation 10/20/93	Coordinates[a]
Settlement plates			
S-1	7146.83	7146.72	N 42600.4/E 45799.5
S-2	7072.57	7072.48	N 42500.0/E 46300.0
S-3	7151.79	7151.58	N 42299.5/E 45700.1
S-4	7144.58	7144.40	N 42299.7/E 46000.2
S-5	7093.95	7093.90	N 42299.8/E 46300.1
S-6	7076.93	7076.88	N 42300.8/E 46400.2
S-7	7122.30	7122.18	N 42200.4/E 45000.4
S-8	7147.30	7147.13	N 42199.6/E 45299.7
S-9	7087.71	7087.66	N 42200.6/E 46400.1
S-10	7146.98	7146.84	N 42100.2/E 46000.1
S-11	7125.55	7125.46	N 42000.5/E 45400.0
S-12	7144.15	7144.02	N 41999.6/E 45700.2
S-13	7111.41	7111.29	N 41964.2/E 46334.6
S-14	7112.53	7112.43	N 41899.8/E 46000.3
Survey monuments			
SM-1	7178.35		N 42692.34/E 44591.44
SM-2	7124.95		N 41370.10/E 45872.37
SM-3	7125.85		N 42035.81/E 46964.05
SM-4	7145.62		N 42804.37/E 46991.91
Boundary monuments			
BMT-1			N 43041.67/E 44,190.57
BMT-2			N 43041.67/E 47,265.57
BMT-3			N 41341.67/E 47,265.57
BMT-4			N 41341.76/E 44,850.01
BMT-5			N 41890.10/E 44,190.74

[a]Based on project survey control points established by the Bureau of Land Management.

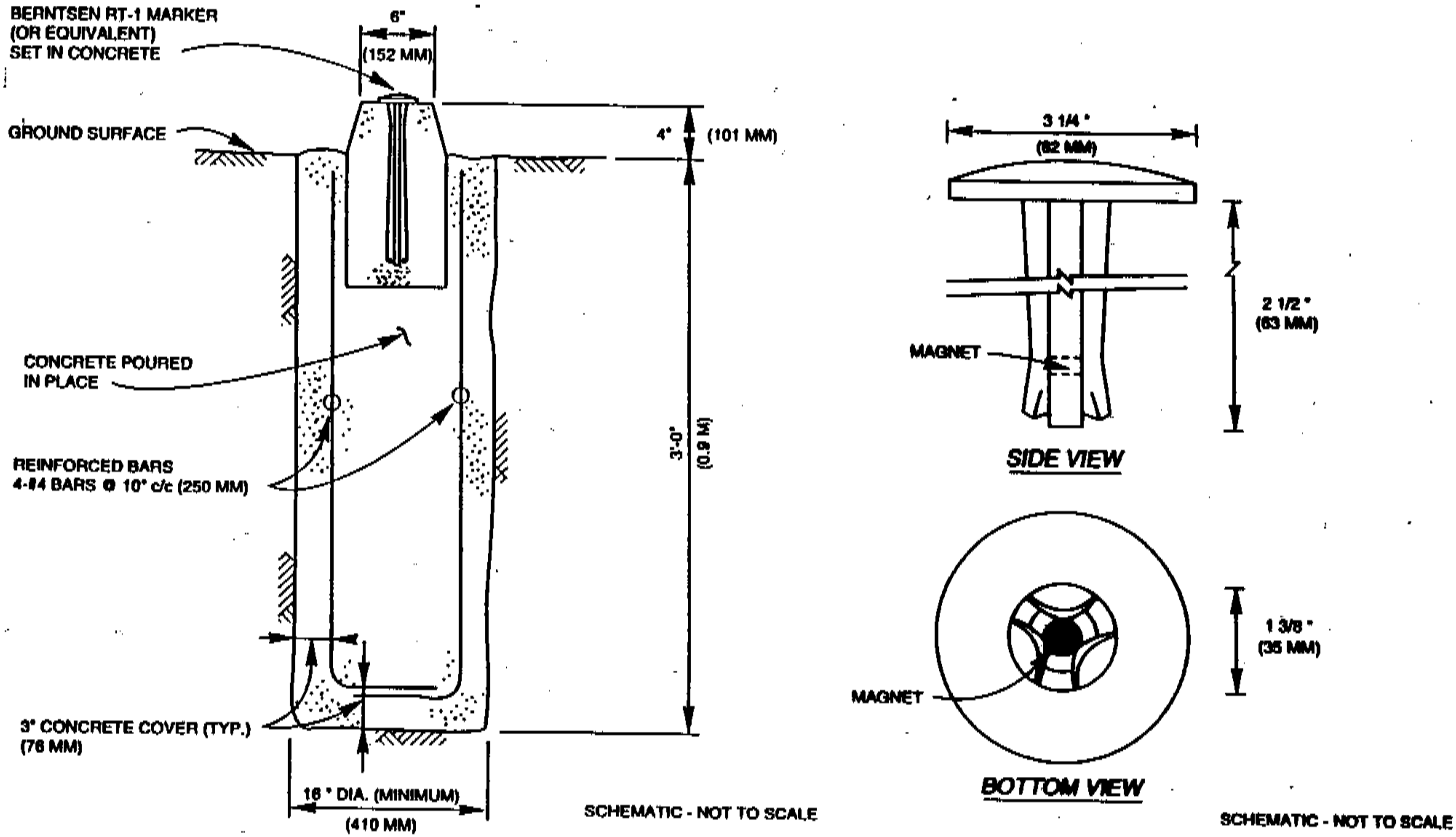


FIGURE 4.1
UMTRA PROJECT SURVEY MONUMENT
BODO CANYON, COLORADO, DISPOSAL SITE

MODIFIED FROM MK-F, 1990.

MAC: SITE/DUR/LTSP/SURVBOUN

DUR LTSP

BERNTSEN FEDERAL ALUMINUM SURVEY MONUMENT, MODEL A-1, STANDARD LOGO CAP

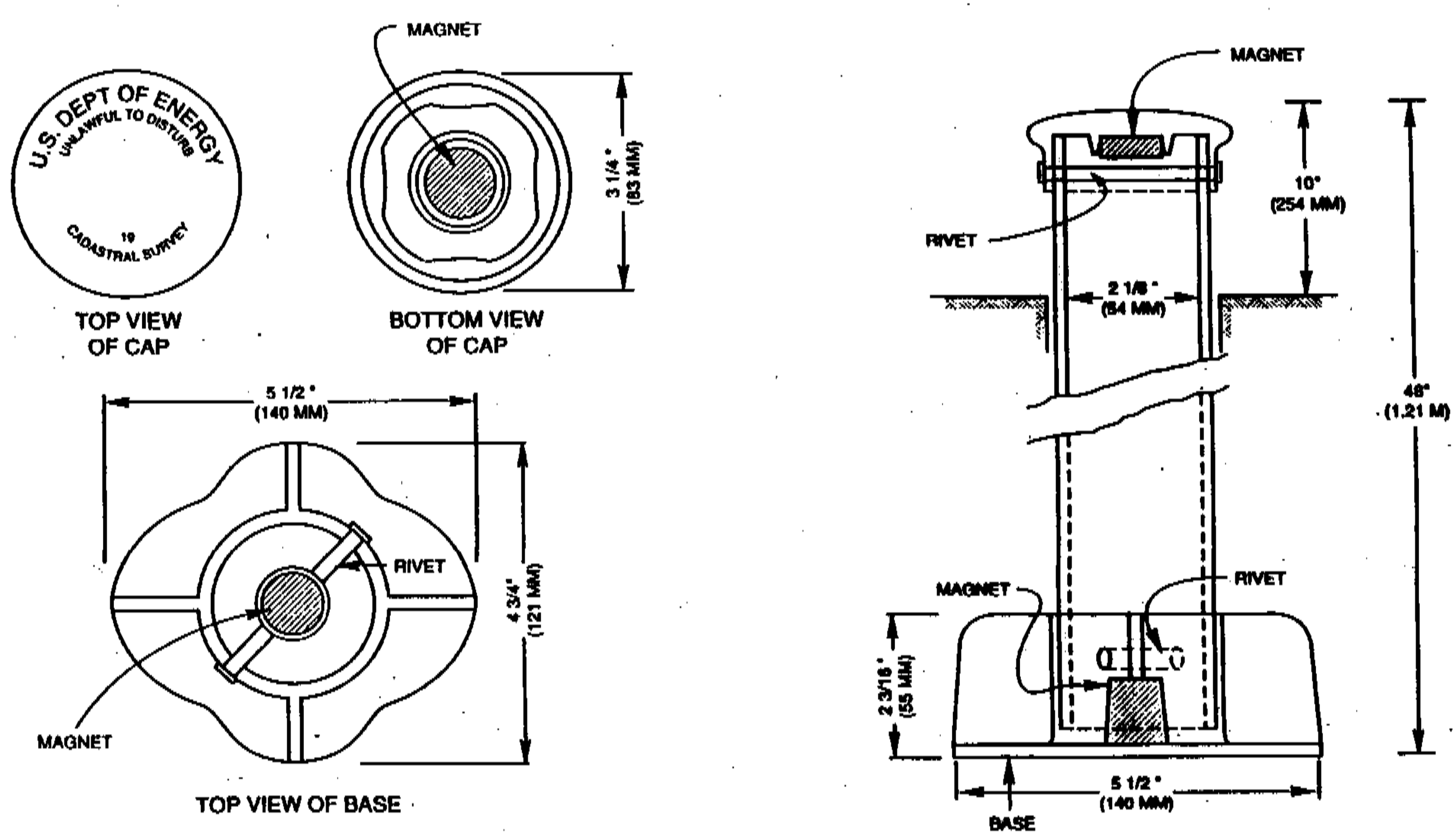
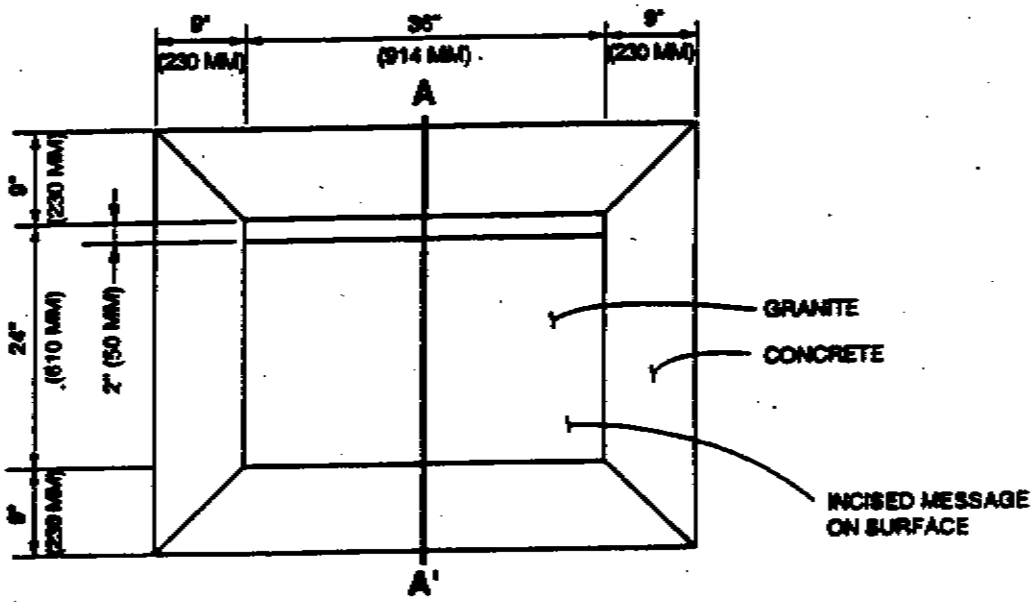
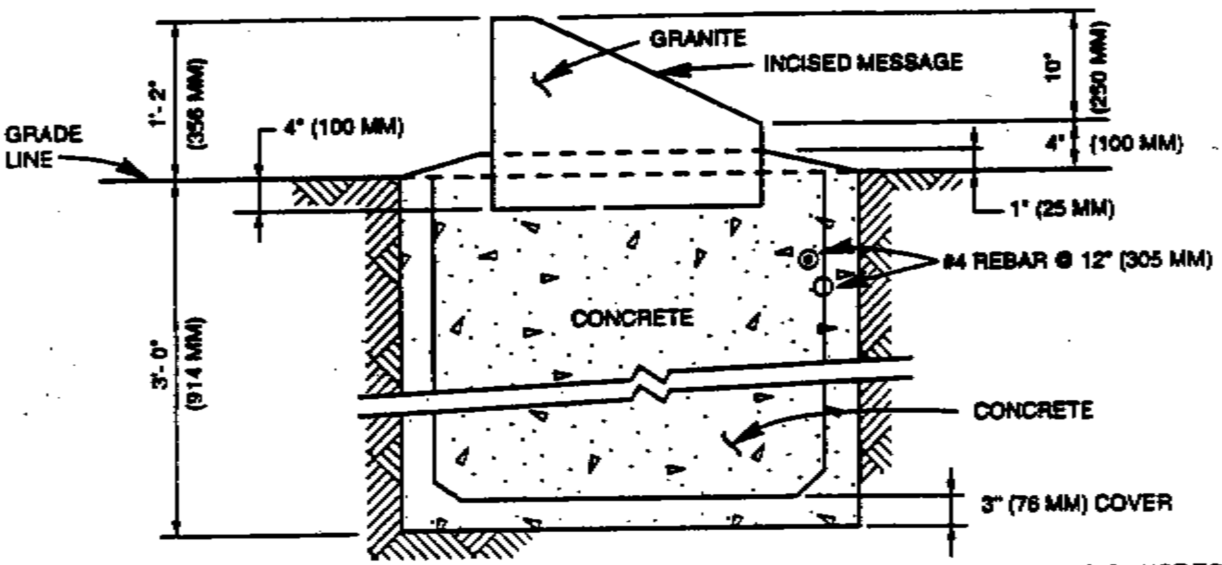


FIGURE 4.2
UMTRA PROJECT BOUNDARY MONUMENT
BODO CANYON, COLORADO, DISPOSAL SITE



PLAN VIEW

SCHEMATIC - NOT SHOWN TO SCALE

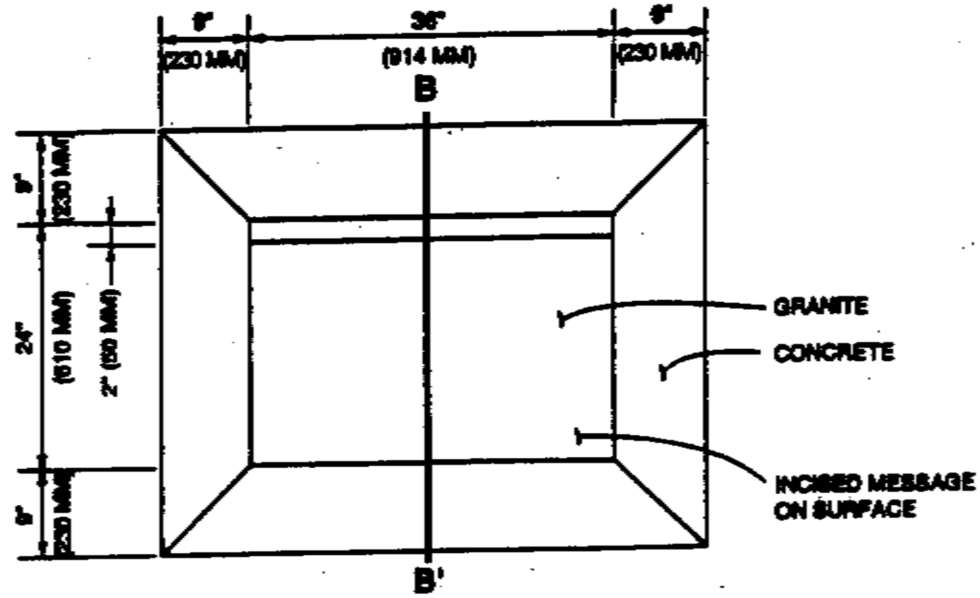


SCHEMATIC - NOT TO SCALE

SECTION A - A'

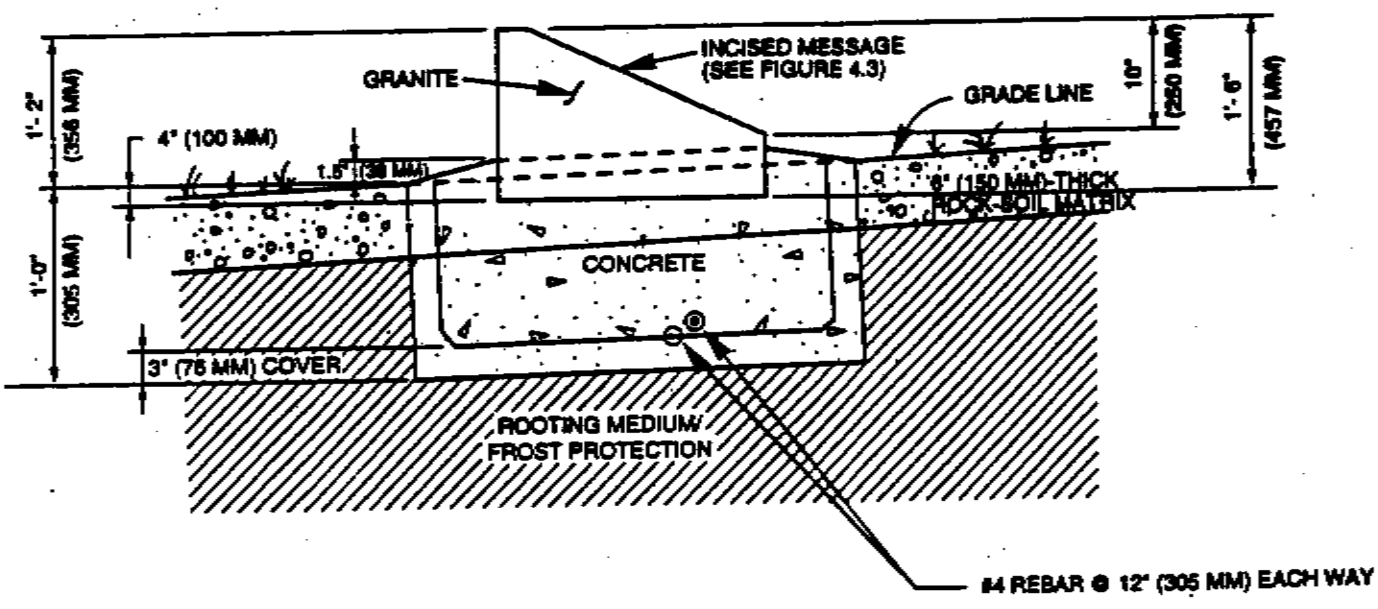
MODIFIED FROM MK-F, 1991

FIGURE 4.3
UMTRA PROJECT ENTRANCE SITE MARKER (SMK-1)
BODO CANYON, COLORADO, DISPOSAL SITE



PLAN VIEW

SCHEMATIC - NOT SHOWN TO SCALE

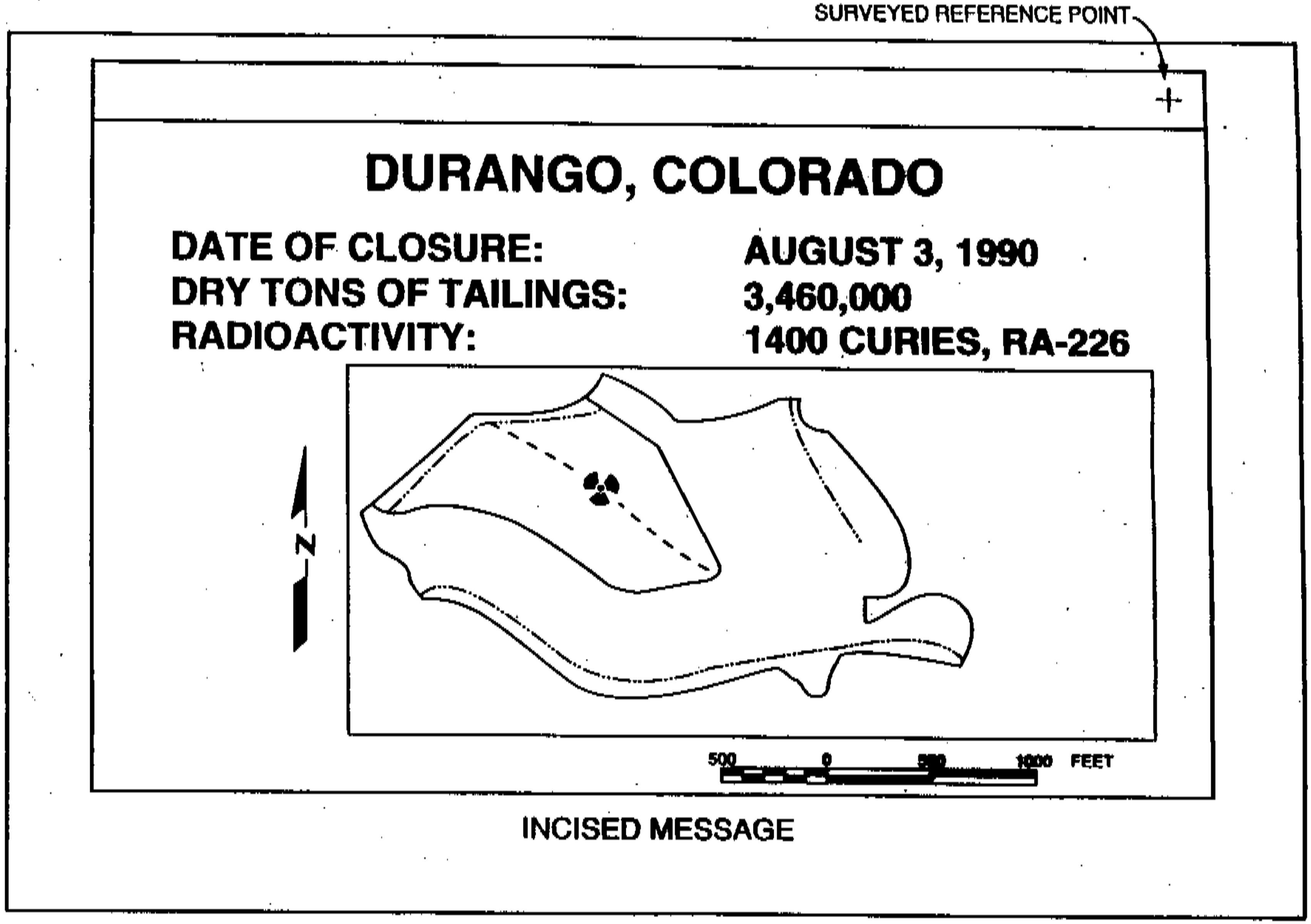


SCHEMATIC - NOT TO SCALE

SECTION B - B'

MODIFIED FROM MK-F, 1991

FIGURE 4.4
UMTRA PROJECT SITE MARKER AT CREST OF DISPOSAL CELL
BODO CANYON, COLORADO, DISPOSAL SITE



NOTE: MINIMUM DEPTH OF INCISING TO BE 0.25" (6 MM)

MODIFIED FROM MK-F, 1990

FIGURE 4.5
UMTRA PROJECT SITE MARKER INCISED MESSAGE
BODO CANYON, COLORADO, DISPOSAL SITE

MAC: SITE/DUH/LTSP/SITEINCISED

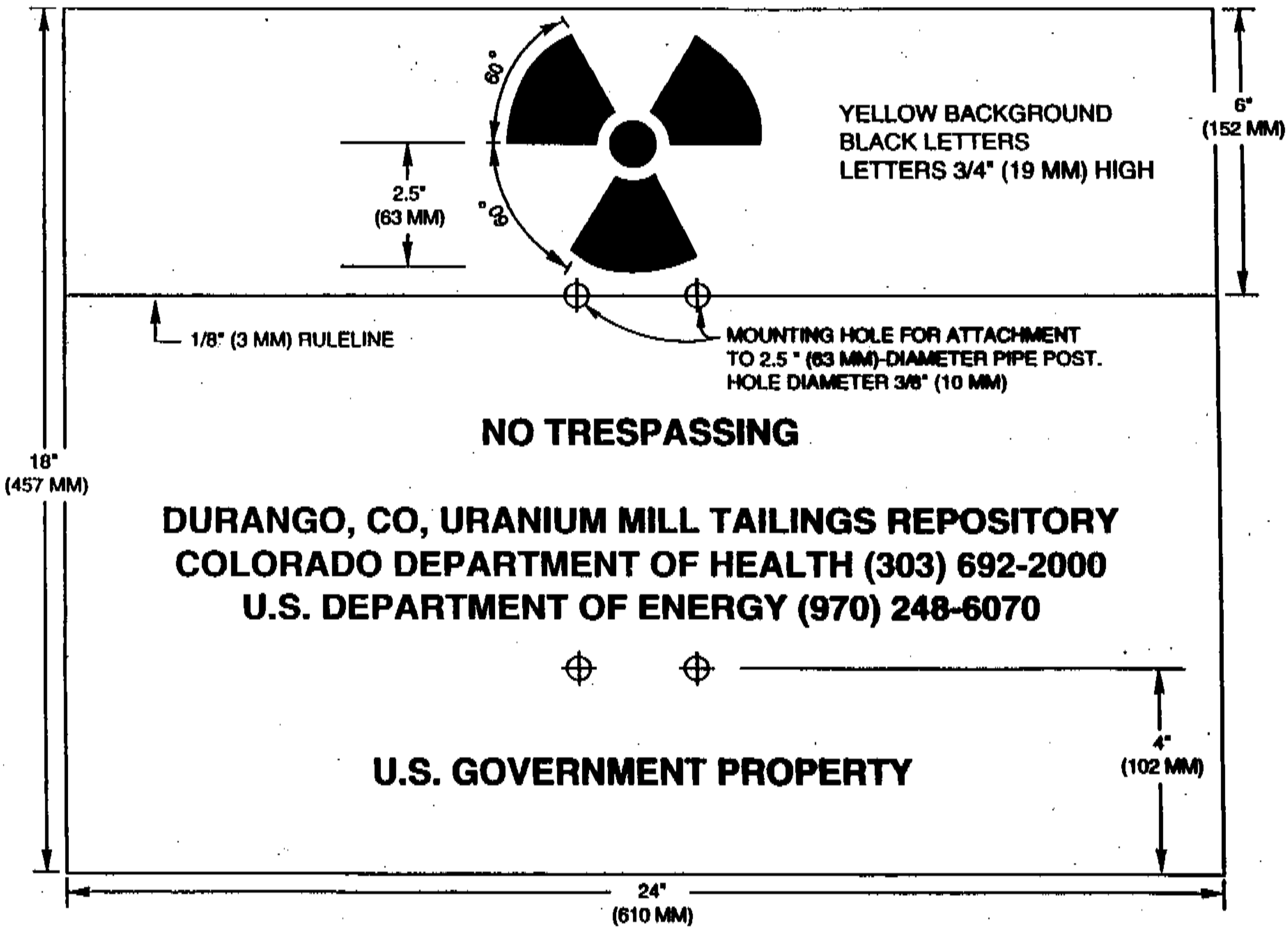


FIGURE 4.6
UMTRA PROJECT ENTRANCE SIGN AND MESSAGE
BODO CANYON, COLORADO, DISPOSAL SITE

SCHEMATIC - NOT TO SCALE

MODIFIED FROM MK-F, 1990

MAC: SITE/DUR/LTSP/ENTSIGN

DUR1 T89

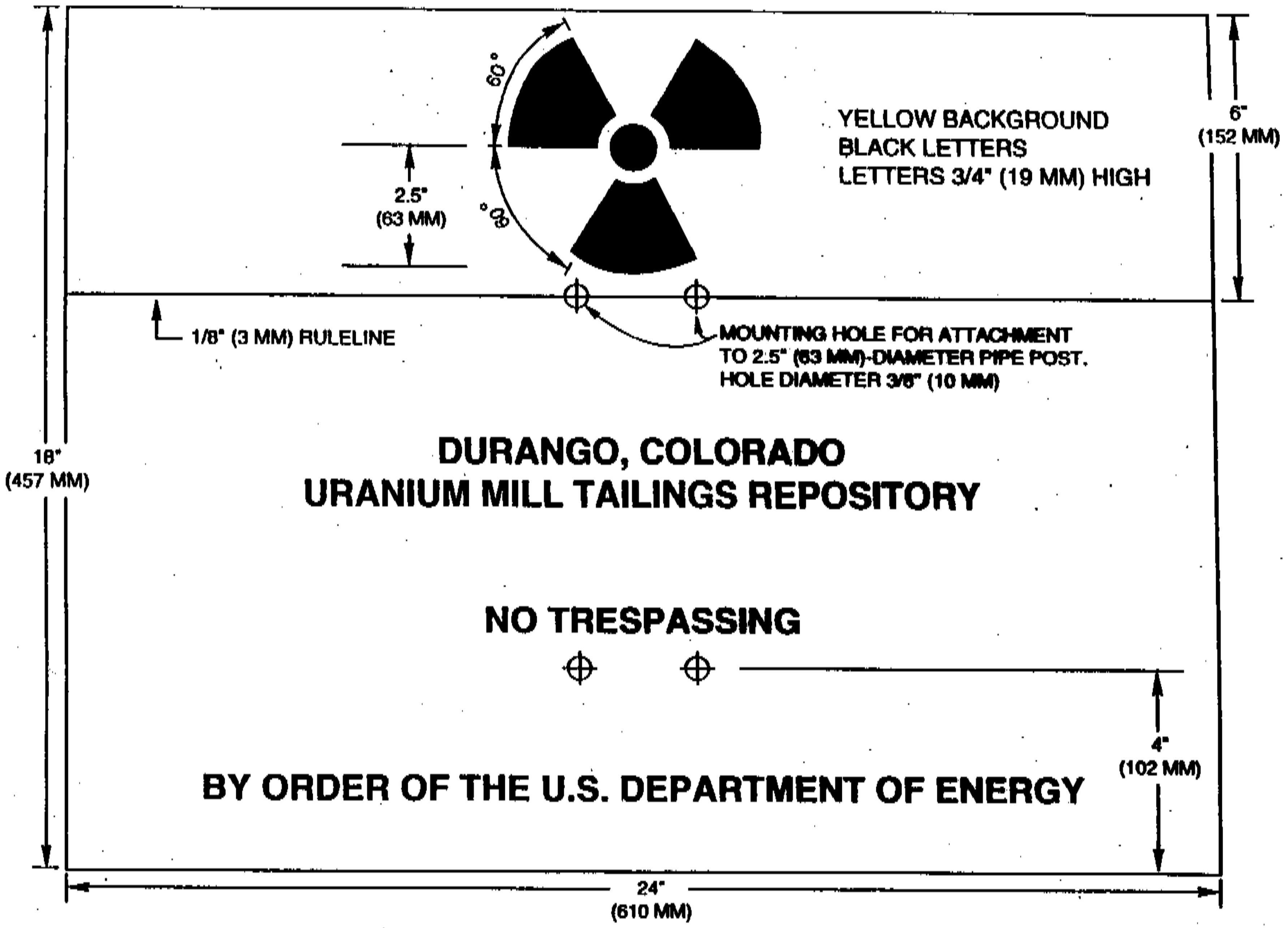


FIGURE 4.7
UMTRA PROJECT PERIMETER SIGN AND MESSAGE
BODO CANYON, COLORADO, DISPOSAL SITE

SCHEMATIC - NOT TO SCALE

MODIFIED FROM MK-F, 1990.

MAC: SITE/DUR/LTSP/PERSIGN

of the DOE GJPO and CDPHE. When the DOE and CDPHE telephone numbers change, the signs will be corrected.

The signs are constructed in accordance with the dimensions and specifications shown in Figures 4.6 and 4.7.

4.5 SETTLEMENT PLATES

Fourteen settlement plates are located on the disposal site, primarily on the south and east sideslopes of the disposal cell (Plate 1). The total long-term settlement of the disposal cell could be measured using the 14 settlement plates. The plates were installed after the disposal cell was completed, using the specifications in Figure 4.8. The coordinate locations are listed in Table 4.1.

4.6 ADDITIONAL SITE-SURVEILLANCE FEATURES

A lined rectangular holding pond at the northeast corner of the disposal cell serves as the collection and treatment point for construction water draining from the base and toe of the disposal cell. An 8-ft (2.4-m) post-and-multiple-stand wire deer fence surrounds the pond; access is gained through an unlocked gate at the northeast corner of the fence.

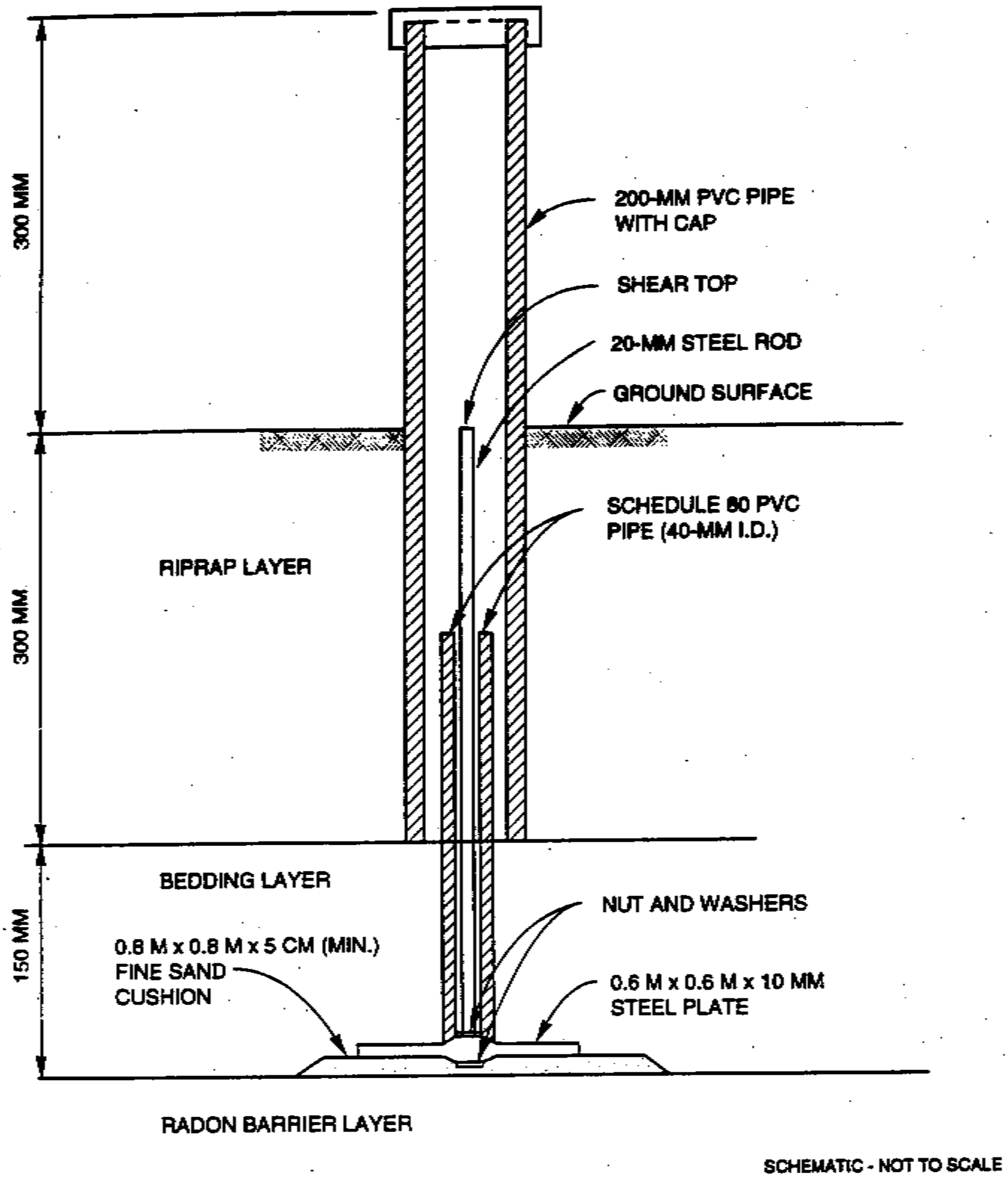


FIGURE 4.8
UMTRA PROJECT SETTLEMENT PLATE
BODO CANYON, COLORADO, DISPOSAL SITE

5.0 GROUND WATER MONITORING

Ground water monitoring at the Bodo Canyon disposal site is required under the regulations in 40 CFR §192.04. The purpose of long-term monitoring is to verify that the performance of the disposal cell complies with the ground water design standards specified in the RAP (DOE, 1991). The ability of the disposal cell to protect ground water depends on its engineering features and on its physical location. The design of the disposal cell minimizes contaminant migration from the disposal cell into foundation materials. The location of the cell at the upper end of the valley prevents infiltration of surface runoff in to the cell. Therefore, drainage from the cell into the foundation material will meet ground water protection standards as a result of the following design considerations:

- The evapotranspiration of precipitation from the rock/soil and vegetative cover will reduce the amount of infiltrating water.
- The highly conductive sand filter/drainage layer on top of the radon barrier will drain much of the infiltrating water to the boundaries of the cell.
- The low permeability of the radon/infiltration barrier on top of the cell will prevent much of the infiltrating water from entering the cell.
- The low permeability and attenuating properties of the liner under the tailings material will reduce the rate of contaminant migration draining from the cell into subsoils beneath the cell.

As a result of these considerations, contaminated water that does filtrate into the subsoils beneath the cell will migrate as unsaturated flow and the contaminant transport will be attenuated through the residual moisture storage capacity of the alluvial material. Contaminant transport also will be attenuated by the natural geochemical adsorption capacity of subdisposal cell sediments. The RAP details these barriers to contaminant transport (DOE, 1991).

5.1 GROUND WATER CHARACTERIZATION

The DOE has characterized the hydrogeologic units and has identified the constituents of concern at the disposal site, which are further discussed below.

5.1.1 Hydrostratigraphy

Physiographic setting

The disposal cell is in a valley that trends southwest-to-northeast. Prior to installation of the disposal cell, the valley elevation ranged from approximately 7190 ft (2190 m) above MSL near the western end of the property to about 6900 ft (2100 m) above MSL at the extreme southeastern corner of the site. Figure 5.1 shows the topography of the surrounding area after the cell was

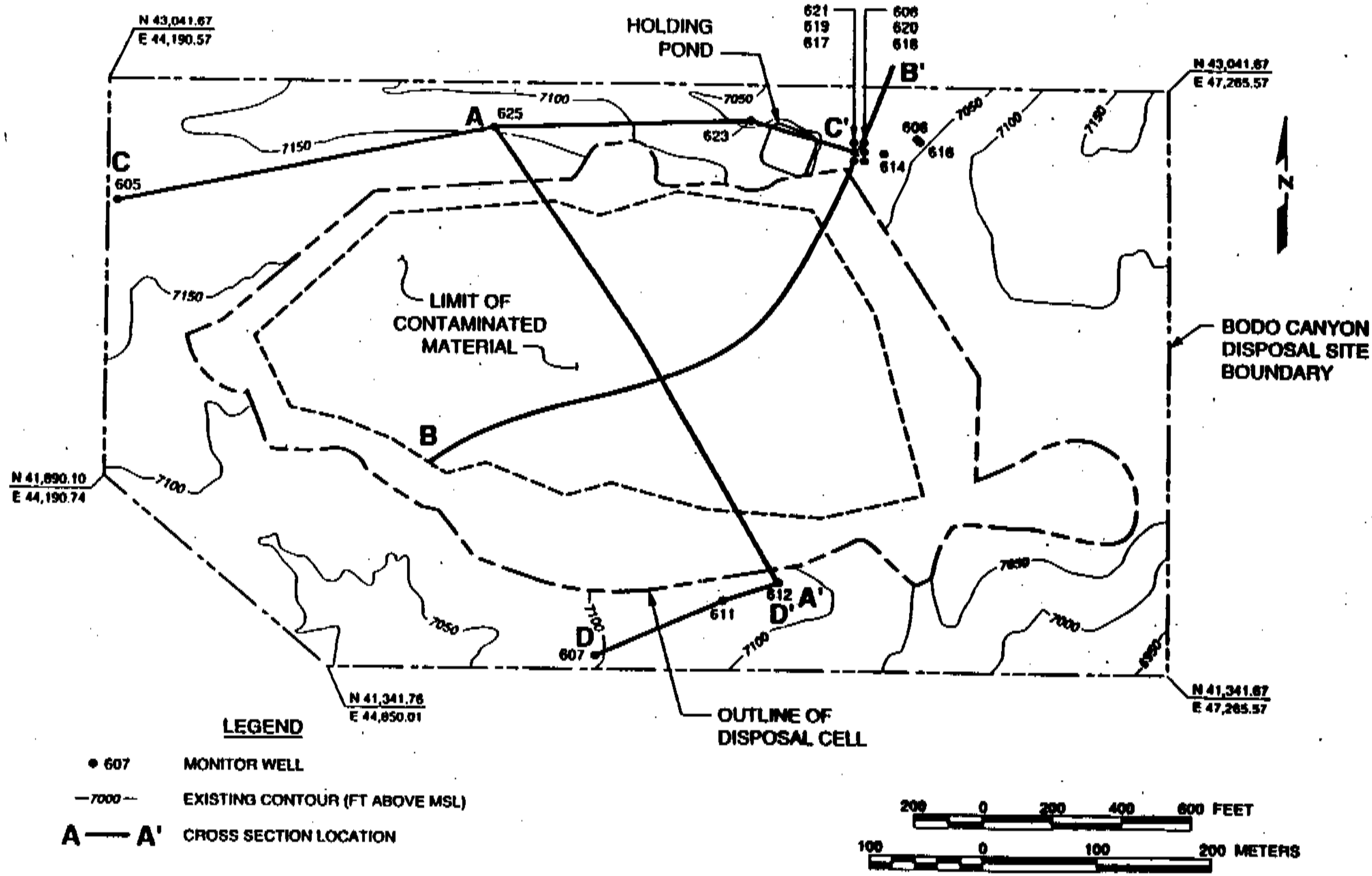


FIGURE 5.1
LOCATIONS OF MONITOR WELLS AND TOPOGRAPHIC MAP
BODO CANYON, COLORADO, DISPOSAL SITE

MAC: SITE/T TSP/MONWELLLOC

completed. The canyon is bordered on both the northern and southern flanks by bedrock-supported ridges (Figure 5.2). The northern ridge is over 7160 ft (2180 m) high, and the southern ridge is over 7100 ft (2160 m) high. Elevation at the top of the disposal cell is approximately 7145 ft (2178 m) above MSL. East-flowing arroyos are located north and south of the two flanking ridges. These arroyos are dry much of the year.

Geology

The bedrock underlying the disposal site and supporting the ridges north and south of the canyon is the Cliff House Sandstone (CGS, 1981). The bedrock dips southeast approximately 9.5 degrees.

The Cliff House Sandstone is approximately 200 ft (60 m) thick and contains two distinct units. The lower unit, which contains about 110 ft (34 m) of interbedded siltstone and sandstone with sandstone beds up to 3 ft (1 m) thick, supports the ridge north of the disposal cell and outcrops in the arroyo south of the south-flanking ridge. The upper unit of the Cliff House Sandstone is more shaley and contains fewer and thinner sandstone beds. This unit is approximately 90 ft (30 m) thick and supports the southern ridge.

The Cliff House Sandstone is underlain by the Menefee Formation, which is between 250 and 350 ft (80 and 110 m) thick. The Menefee Formation outcrops in the arroyo at the extreme northeastern corner of the site. The contact between the lower unit of the Cliff House Sandstone and the Menefee Formation is distinguished primarily by evidence of coal and carbonized fragments in the Menefee. Otherwise, the gross lithologies of the two formations are very similar.

A paleochannel trending southwest-northeast in the lower unit of the Cliff House Formation parallels the axis of the valley occupied by the disposal cell (Figure 5.1). This paleochannel intersects the valley occupied by the east-flowing arroyo north of the disposal cell.

The paleochannel is filled with as much as 65 ft (20 m) of alluvium consisting of silty clay, silt, and sand with some sandstone and shale fragments. This alluvium thins and is absent along the sides of the ridges north and south of the disposal cell. During remedial action, the alluvium was shaped and compacted with additional imported silty clay and clay soil, forming a low-permeability base for the disposal cell, and restricting the downward migration of contaminants (Figures 5.2 and 5.3).

Ground water (bedrock)

Ground water elevations measured in monitor wells drilled into the bedrock beneath the cell before its construction, and into the bedrock north, south, and east of the cell, do not clearly identify a piezometric surface, flow direction, or gradient. Ground water relatively near the land surface (within 100 ft [30 m])

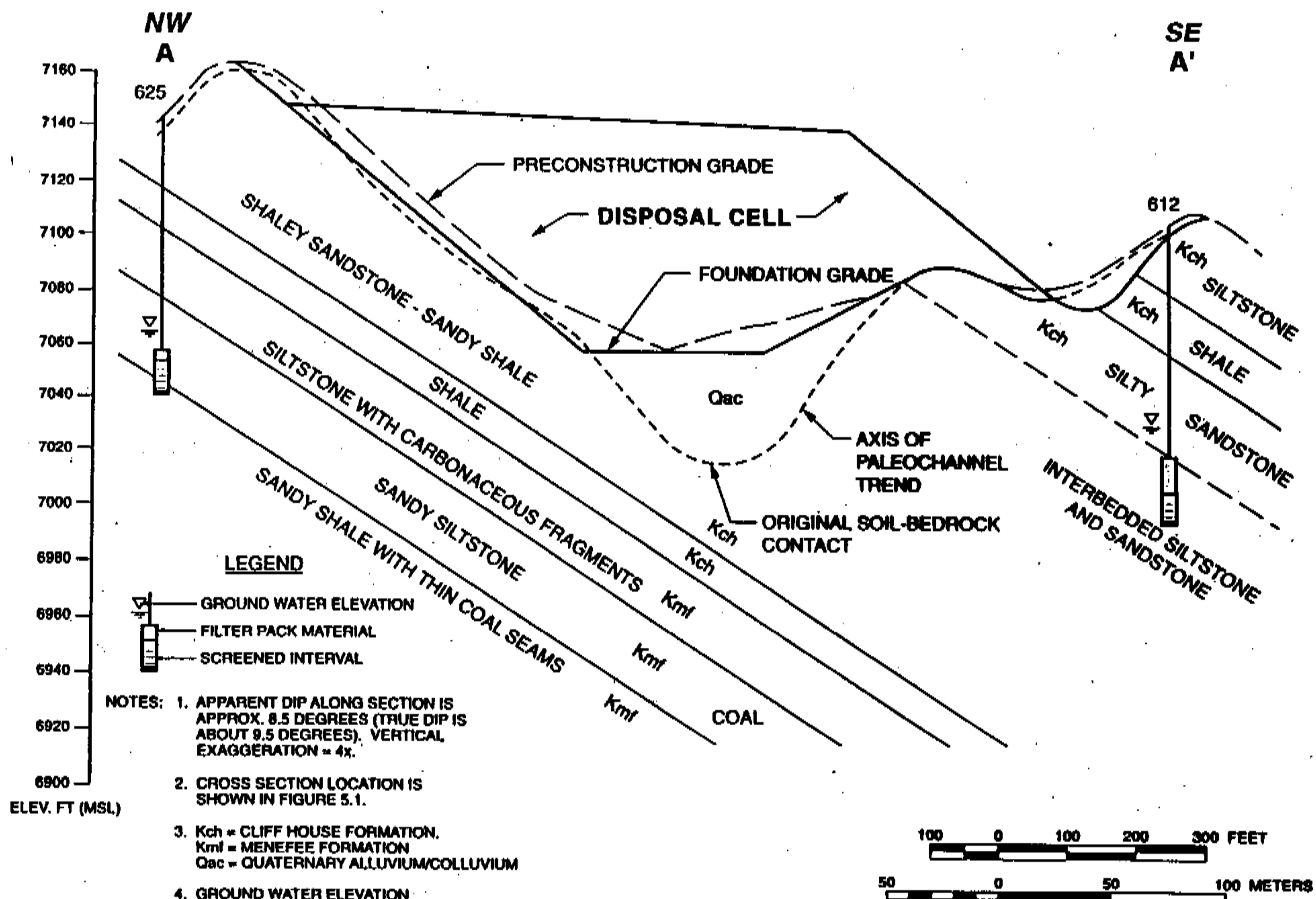
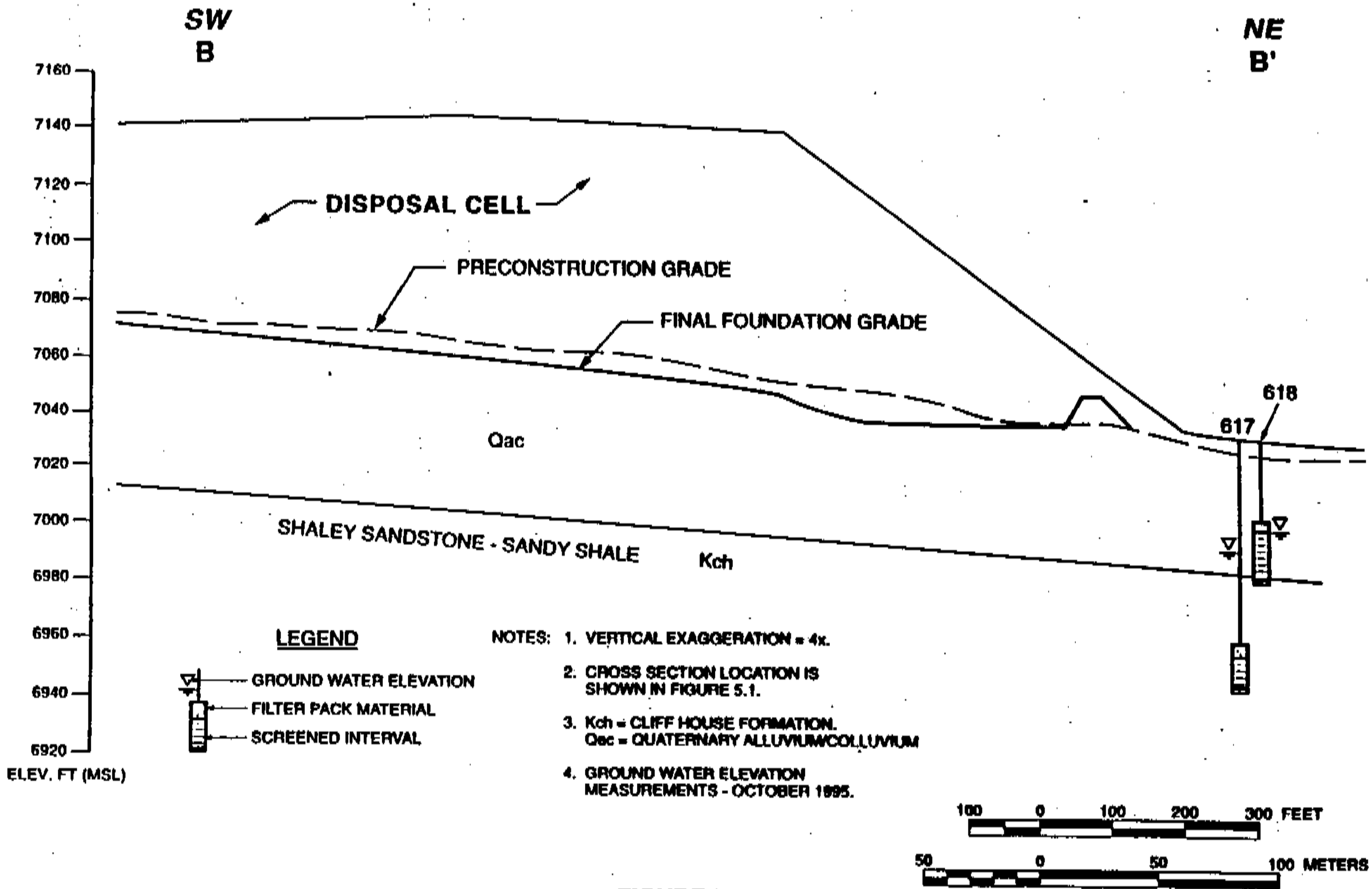


FIGURE 5.2
SCHEMATIC CROSS SECTION A - A'
BODO CANYON, COLORADO, DISPOSAL SITE

MAC: SITE/DUR/ ~P/SCHM-XSEC(A-A')



NOTES:
1. VERTICAL EXAGGERATION = 4x.
2. CROSS SECTION LOCATION IS SHOWN IN FIGURE 5.1.
3. Kch = CLIFF HOUSE FORMATION. Qac = QUATERNARY ALLUVIUM/COLLUVIUM
4. GROUND WATER ELEVATION MEASUREMENTS - OCTOBER 1995.

FIGURE 5.3
SCHEMATIC CROSS SECTION B - B'
BODO CANYON, COLORADO, DISPOSAL SITE

MAC: SITE/DUR/LTSP/SCHM-XSECIB-B1

apparently occurs in different layers within the bedrock and these ground water bodies may have limited areal extent. Recharge of the near-surface ground water in the bedrock is probably only from local precipitation and is unrelated to the deeper, regional flow regime. Ground water in the shallow bedrock appears to flow both southeast, in the direction of the dip of the bedrock, and northeast, down the trend of the valley in the same direction as the ground water in the alluvium.

Three hydraulic gradients were calculated from three point-solutions used to define the southeastern direction of potential ground water flow in the bedrock. The average hydraulic gradient is 0.19 ft/ft. The average potential ground water velocity was calculated using Darcy's law, assuming a porosity of 0.15 and the geometric mean of hydraulic conductivity (0.07 ft [.02 m] per day). The average potential ground water linear velocity to the southeast is 32 ft (9.8 m) per year in the bedrock aquifer (DOE, 1991).

<u>Ground water (alluvium)</u>

Shallow ground water occurs locally within the alluvium in the valley bottom. The depth to ground water prior to construction of the disposal cell varied seasonally and several boreholes in the mid- to upgradient areas beneath the disposal cell did not encounter water above the bedrock. Ground water in the shallow alluvium was encountered mostly northeast of the disposal cell, near well 606. During the wet season, ground water was at or near the ground surface. The hydraulic conductivity of the shallow alluvium in most of the valley averages approximately 0.13 ft per day (0.46×10^{-4} cm per second), although an aquifer test performed at the confluence of the paleochannel and the north arroyo gave a value of 32 ft (10 m) per day. Assuming a porosity of 0.25 and a gradient of 0.003 down the valley center, the rate of movement to the northeast will vary from approximately 0.6 ft (0.2 m) per year to about 140 ft (40 m) per year. This amount of variability is not unusual for alluvium-filled valleys. For calculations of potential downward movement of ground water, the vertical conductivity is assumed to be one-third of the horizontal hydraulic conductivity.

The disposal cell fills more than 85 percent of the original valley. Prior to construction of the disposal cell, most of the alluvium in the western two-thirds of the valley was not saturated. The design of the cell, including the compacted soil beneath it and the extremely low-permeability radon and infiltration barriers on its top, prevents precipitation and snowmelt from percolating through the cell into the subsurface and recharging the ground water. As a result, the limited area of alluvial system saturation in the mid- to upgradient areas beneath the disposal cell are expected to dewater with time.

5.1.2 Monitor well network

In 1995, 15 monitoring wells existed at the Bodo Canyon disposal site (Figure 5.1). These wells, their locations, depth of the screened interval, and number of times sampled are listed in Table 5.1.

5.1.3 Background ground water quality

Because of the limited area of alluvial system saturation under natural conditions and the desaturation expected in the alluvium beneath the disposal cell, the bedrock aquifer (also called the Cliff House/Menefee aquifer) is considered the uppermost aquifer at the Bodo Canyon site (DOE, 1991).

Background ground water quality in the bedrock aquifer has been determined from samples from nine monitor wells completed in the bedrock aquifer. These wells are located both upgradient and downgradient of the disposal cell (Table 5.1). Data collected from 1987 through 1994 are used to characterize background water quality. Although these data were collected prior to, during, and after tailings placement at the disposal site, these data are representative of natural background ground water for the following reasons. Prior to construction of the disposal cell, the disposal site was used as pastureland managed by the Bureau of Land Management. No mining or milling activities took place at the disposal site before placement of the cell. During placement of the cell, samples of the liner were collected and analyzed for chemical evidence of tailings solutions seeping through the scarified clay liner. No evidence for seepage into or through the scarified clay liner was found (DOE, 1991). Finally, notable changes in ground water quality have not been observed in monitor wells sampled prior to, during, and after cell construction.

Background ground water quality in the bedrock aquifer varies between wells, primarily because the amount of dissolved sulfate salts varies between wells. These salts are thought to be derived from the dissolution of natural gypsum in the aquifer. Total dissolved solids range from 670 to 7440 milligrams per liter (mg/L). Major anions include sulfate and/or bicarbonate. Sodium is generally the major cation. The ground waters are generally oxidizing; however, measured oxidation-reduction potentials vary in individual wells from reducing (as low as -353 millivolts [mV]) to oxidizing (up to 768 mV). Ground waters in the bedrock aquifer also range from alkaline (average pH of 8.9 in well 609) to acid (average pH of 4.9 in well 621). The acidic water in well 621 and in adjacent well 616 is thought to be due to the natural oxidation of pyrite (iron sulfide) in the aquifer. The naturally acidic water is associated with high levels of dissolved iron (up to 452 mg/L), manganese (up to 6.04 mg/L), sulfate (up to 4000 mg/L) and sulfide (up to 16 mg/L). Indicators of ground water contamination from tailings solutions (uranium, molybdenum, and selenium, as discussed in Section 5.2.3) are not present at levels above background in wells 621 and 616. Trace constituents that have been detected at least once in background samples include antimony, arsenic, beryllium, cadmium, chromium,

Table 5.1 Monitor wells at the Bodo Canyon, Colorado, disposal site

Well	Location	Screened interval (depth below surface) (ft)	Screened interval (depth below surface) (m)	Year sampled	Number of sampling rounds
Alluvial aquifer					
DUR-03-0606	downgradient, NE	14 - 34	4.3 - 10.4	87-94	20
DUR-03-0608	downgradient, NE	29 - 39	8.8 - 11.9	87-94	25
DUR-03-0614	downgradient, NE	22 - 42	6.7 - 12.8	89-93	13
DUR-03-0618	downgradient, NE	30 - 50	9.1 - 15.2	90-94	5
DUR-03-0620	downgradient, NE	29 - 49	8.8 - 14.9	90-94	3
DUR-03-0623	upgradient, North	19 - 39	5.8 - 11.9	89-94	18
Bedrock aquifer (Cliff House/Menefee aquifer)					
DUR-03-0605[a]	upgradient, NW	36 - 56	11.0 - 17.1	87-94	21
DUR-03-0607[b]	downgradient, South	37 - 57	11.3 - 17.4	87-94	20
DUR-03-0609[c]	downgradient, SE	144 - 176	43.9 - 53.6	88-90	7
DUR-03-0611	downgradient, South	108 - 118	32.9 - 36.0	90-94	7
DUR-03-0613[c]	downgradient, SE	68 - 78	20.7 - 23.8	89-90	2
DUR-03-0612[b]	downgradient, South	98 - 108	29.9 - 32.9	89-94	14
DUR-03-0616	downgradient, NE	89 - 99	27.1 - 30.2	89-94	10
DUR-03-0617	downgradient, NE	80 - 90	24.4 - 27.4	-	0
DUR-03-0619	downgradient, NE	79 - 89	24.1 - 27.1	-	0
DUR-03-0621[b]	downgradient, NE	78 - 88	23.8 - 26.8	90-94	18
DUR-03-0625	upgradient, North	89 - 99	27.1 - 30.2	89-94	8

[a]Background well for routine screening monitoring.
[b]Point-of-compliance well.
[c]Decommissioned well.

lead, mercury, molybdenum, nickel, radium-226, radium-228, selenium, silver, thallium, uranium, and vanadium (Table 5.2).

The variation in background water quality within the bedrock aquifer probably reflects local variations in lithology and perhaps changes in oxidation-reduction conditions related to the natural movement of dissolved oxygen and ground water through the aquifer. It is possible that changes in water quality in individual wells will occur in response to future natural variations in ground water flow and oxidation-reduction conditions. To reduce the chance that future naturally occurring variation will be mistaken for contamination from the disposal cell, a single broad definition of background water quality has been developed. This definition combines all data from sampled bedrock wells in the disposal cell area.

5.1.4 Hazardous constituents

Hazardous constituents were identified by characterizing tailings solutions sampled from monitor wells completed within the Bodo Canyon disposal cell (Table 5.2). Additionally, analyses of effluent from the disposal cell toe drain were compared to analyses of tailings solutions to provide further information about the levels of hazardous constituents derived from the tailings. In general, the toe drain results and monitoring well results are in agreement (Table 5.2).

Concentration levels measured in tailings wells were statistically compared to levels measured in bedrock wells to determine which of the hazardous constituents listed in Table 1 to Subpart A and Appendix I to 40 CFR Part 192 are present in the RRM at levels above ambient background (60 FR 2854). The nonparametric Mann-Whitney test (Lehmann, 1975) was used, and a 0.05 level of significance was employed for each tested constituent. Arsenic, cadmium, molybdenum, radium-226, selenium, uranium, and vanadium are significantly elevated in tailings pore fluids both from a statistical and a practical perspective, as the median concentration from tailings pore fluids exceed the median background level by at least 1 order of magnitude.

A second group of hazardous constituents, including beryllium, chromium, mercury, nickel, and silver, were determined to be statistically elevated in tailings pore solution compared to background, although in more than half the tailings samples, they were below detection limits. Furthermore, the detected concentrations from tailings solutions were not remarkably higher than the detection limits or than observable background levels. The statistical significance of these constituents is attributable primarily to their greater frequency of detection in tailings samples than in background samples. These constituents are retained as hazardous constituents at the Bodo Canyon disposal site, but are not expected to be reliable indicators of potential ground water contamination because they occur infrequently in the tailings solutions and are below detection in the toe drain effluent, and they occur at levels near background and likely will be attenuated by reactions with clay liner and alluvial

Table 5.2 Summary of water quality data for tailings solutions, background ground water, and toe drain effluent, Bodo Canyon, Colorado, disposal site

Parameter	Frequency of detection	Minimum	Median	Maximum
MAJOR ELEMENTS AND FIELD PARAMETERS				
Alkalinity				
Tailings	15/15	303	590	770
Background	94/94	2	694	2032
Toe drain	1/1	—	593	—
Calcium				
Tailings	15/15	513	583	609
Background	88/88	2	161	545
Toe drain	1/1	—	566	—
Chloride				
Tailings	15/15	59	75	210
Background	85/85	6	36	428
Toe drain	1/1	—	70	—
Iron				
Tailings	15/15	0.09	0.14	0.63
Background	80/88	0.02	0.33	452
Toe drain	1/1	—	0.13	—
Magnesium				
Tailings	15/15	41	69	166
Background	88/86	1.2	143	458
Toe drain	1/1	—	62	—
Manganese				
Tailings	15/15	3.0	6.0	8.6
Background	84/92	<0.01	0.06	6.0
Toe drain	1/1	—	4.5	—
pH				
Tailings	15/15	6.29	6.63	7.57
Background	97/97	4.72	6.88	11.14
Toe drain	1/1	—	7.65	—
Oxidation-reduction potential				
Tailings	0/0	—	NA	—
Background	43/43	-353	204	768
Toe drain	0/0	—	NA	—
Potassium				
Tailings	15/15	13	17	31
Background	88/88	3.4	7.2	40
Toe drain	1/1	—	18	—

Table 5.2 Summary of water quality data for tailings solutions, background ground water, and toe drain effluent, Bodo Canyon, Colorado, disposal site (Continued)

Parameter	Frequency of detection	Minimum	Median	Maximum
Sodium				
Tailings	15/15	122	228	727
Background	88/88	105	336	1370
Toe drain	1/1	-	238	-
Sulfate				
Tailings	15/15	1540	1710	2800
Background	79/79	23	925	4000
Toe drain	1/1	—	1770	—
Total dissolved solids				
Tailings	15/15	2790	3250	5080
Background	79/79	932	2750	7440
Toe drain	1/1	—	3200	—
LISTED HAZARDOUS CONSTITUENTS (Table A and Appendix I, 40 CFR Part 192)				
Antimony				
Tailings	0/0	—	NA	—
Background	9/46	<0.003	<0.003	0.027[a]
Toe drain	1/1	—	<0.003	—
Arsenic[b]				
Tailings	15/15	0.09	0.19	0.57
Background	12/92	<0.001	<0.01	0.03[a]
Toe drain	1/1	—	0.34	—
Barium				
Tailings	0/15	<0.10	<0.10	<0.10
Background	27/72	<0.01	<0.10	0.90
Toe drain	1/1	—	<0.01	—
Beryllium[b]				
Tailings	5/15	<0.01	<0.01	0.16
Background	5/52	<0.005	<0.01	0.023
Toe drain	1/1	—	<0.01	—
Cadmium[b]				
Tailings	15/15	0.014	0.037	0.063
Background	14/92	<0.001	<0.001	0.019
Toe drain	1/1	—	0.019	—

Table 5.2 Summary of water quality data for tailings solutions, background ground water, and toe drain effluent, Bodo Canyon, Colorado, disposal site (Continued)

Parameter	Frequency of detection	Minimum	Median	Maximum
Chromium[b]				
Tailings	5/15	<0.01	<0.01	0.26
Background	6/72	<0.01	<0.01	0.12
Toe drain	1/1	—	<0.01	—
Cyanide				
Tailings	0/10	<0.01	<0.01	<0.01
Background	1/30	<0.01	<0.01	0.18
Toe drain	0/0	—	NA	—
Lead				
Tailings	7/15	<0.01	<0.01	0.02
Background	9/88	<0.001	<0.01	0.02[a]
Toe drain	1/1	—	<0.01	—
Mercury[b]				
Tailings	5/15	<0.0002	<0.0002	<0.0004
Background	4/68	<0.0002	<0.0002	<0.0004
Toe drain	1/1	—	<0.0002	—
Molybdenum[b]				
Tailings	15/15	0.81	1.73	3.98
Background	25/92	<0.01	<0.01	0.22
Toe drain	1/1	—	1.69	—
Net gross alpha				
Tailings	1/15	0.0	0.0	67
Background	48/82	0.0	2.9	35
Toe drain	0/0	—	NA	—
Nickel[b]				
Tailings	3/5	<0.04	0.04	0.07
Background	7/58	<0.01	<0.04	0.07
Toe drain	1/1	—	0.060	—
Nitrate				
Tailings	9/15	<1.0	1.6	22
Background	38/87	<0.1	<1.0	43
Toe drain	1/1	—	<0.1	—
Radium-226[b]				
Tailings	15/15	5.9	9.9	18
Background	12/90	<0.1	<1.0	2.0
Toe drain	1/1	—	14.0	—

Table 5.2 Summary of water quality data for tailings solutions, background ground water, and toe drain effluent, Bodo Canyon, Colorado, disposal site (Concluded)

Parameter	Frequency of detection	Minimum	Median	Maximum
Radium-228				
Tailings	0/15	<1.0	<1.0	<1.0
Background	20/90	<0.9	<1.0	15
Toe drain	1/1	—	1.0	—
Selenium[b]				
Tailings	15/15	0.045	0.13	0.41
Background	18/92	<0.001	<0.005	0.042[a]
Toe drain	1/1	-	0.093	-
Silver[b]				
Tailings	7/15	<0.01	<0.01	0.07
Background	2/68	<0.01	<0.01	0.03
Toe drain	1/1	—	0.01	—
Thallium				
Tailings	0/15	<0.01	<0.01	<0.01
Background	1/35	<0.01	<0.01	0.01[a]
Toe drain	1/1	—	<0.01	—
Uranium[b]				
Tailings	15/15	1.5	4.5	22
Background	53/89	<0.001	0.001	0.077
Toe drain	1/1	—	4.0	—
Vanadium[b]				
Tailings	5/5	5.7	11	14
Background	27/79	<0.01	<0.01	0.06
Toe drain	1/1	—	14	—

[a]Maximum observed above detection.
[b]Constituents in tailings having concentrations significantly greater than background (at the 95 percent confidence level).

Notes:
1. All data in milligrams per liter except for the following: net gross alpha, radium-226, and radium-228 (in picocuries per liter); pH in standard units; oxidation-reduction potential in millivolts.
2. Data for background are from wells completed in the bedrock aquifer (monitor wells 605, 607, 609, 611, 612, 613, 616, 617, 621, and 625). Data are for filtered samples collected from 1987 through 1994.
3. Data for tailings solutions are from wells completed within the disposal cell (monitor wells 200, 201, 202, 203, and 204). Data are for filtered samples collected from 1987 through 1990.
4. Data for the toe drain effluent from Attachment 3, Table 3.22 of the RAP (DOE, 1991).
5. Dash indicates not applicable (only one measurement available).

NA - not analyzed.

material. These reactions will reduce concentrations to background levels before the bedrock aquifer is reached.

Several constituents listed in Table A or Appendix I of 40 CFR Part 192 either were not detected in the tailings or toe drain effluent (antimony, barium, cyanide, net gross alpha, and thallium) or occurred at levels equal to or less than levels found in background ground waters based on statistical testing (lead, nitrate, and radium-228). These constituents are not designated as hazardous constituents at the Bodo Canyon disposal site.

5.1.5 Concentration limits for hazardous constituents

Concentration limits for long-term monitoring of the disposal cell (Table 5.3) were established following EPA guidance (EPA, 1992). On pages 49 to 56, this EPA document endorses the use of tolerance intervals for detecting contamination above background in one or more downgradient wells. A tolerance interval is designed to contain all but a small percentage of all future measurements from wells accessing uncontaminated water. Therefore, repeated exceedances of the upper tolerance limit present statistical evidence of contamination.

Due to inherent uncertainties at the Bodo Canyon site concerning the geographic and statistical distribution of naturally occurring constituents in the ground water, a nonparametric approach was used to determine a tolerance interval for the hazardous constituents. Using this approach, the upper tolerance limit is the maximum observed concentration in bedrock well samples collected between 1987 and 1994. At the Durango site, the maximum concentrations are based on databases ranging from 52 measurements for beryllium up to 92 measurements for cadmium, chromium, and selenium. There is 95 percent confidence the maximum observed concentration of each constituent represents a level that will exceed background no more than 5 percent of the time. Therefore, using the maximum observed concentration as a concentration limit for long-term ground water monitoring produces reasonable protection against false positive results from random background variation.

Regulations allow the concentration limit for hazardous constituents on Table 1 of Subpart A be set at the background or maximum concentration limit (MCL), whichever is greater. Therefore, the proposed concentration limits for hazardous constituents listed in Table 5.3 represent the larger of the maximum observed concentration and the UMTRA Project MCL for constituents with established MCLs.

5.2 GROUND WATER PROTECTION MONITORING PLAN

The ground water protection monitoring plan includes monitoring the uppermost aquifer and analyzing ground water samples from a series of monitor wells downgradient from the disposal cell at the point of compliance (POC) and upgradient from the disposal cell as background. This direct monitor well

Table 5.3 Proposed concentration limits for hazardous constituents in tailings solutions, Bodo Canyon, Colorado, disposal site

Constituent	MCL	Tailings pore fluid median[a]	Cliff House/Menefee background ground water: Observed maximum[a]	Cliff House/Menefee background ground water: Median[a]	Proposed concentration limit[a]
Arsenic	0.05	0.19	0.03	<0.01	0.05[b]
Cadmium	0.01	0.037	0.019	<0.001	0.019[c]
Chromium	0.05	<0.01	0.12	<0.01	0.12[c]
Mercury	0.002	<0.0002	0.0004	<0.0002	0.002[b]
Molybdenum	0.1	1.73	0.22	<0.01	0.22[c]
Radium-226 and -228	5.0	10.1	15	<2.0	15.0[c]
Selenium	0.01	0.13	0.042	<0.005	0.042[c]
Silver	0.05	<0.01	0.03	<0.01	0.05[b]
Uranium	0.044	4.5	0.077	0.001	0.077[c]
Beryllium	None	<0.01	0.023	<0.01	0.023[d]
Nickel	None	0.04	0.07	<0.04	0.07[d]
Vanadium	None	11	0.06	<0.01	0.06[d]

[a]In Cliff House/Menefee uppermost aquifer at point of compliance.
[b]Observed maximum in background less than maximum concentration limit.
[c]Observed maximum background greater than maximum concentration limit.
[d]Observed maximum in background.

Note: All units reported in milligrams per liter except radium-226 and -228, which are reported in picocuries per liter.

network is discussed below (Section 5.2.1). Performance monitoring frequency is outlined in Section 5.2.2 below.

All aspects of the ground water monitoring plan will be conducted in accordance with accepted industry QA practices, including directives in DOE Orders 5700.6C, *Quality Assurance*, and 5400.1, *General Environmental Protection Program*.

5.2.1 Direct ground water monitoring network

Ground water samples will be collected from upgradient monitor well 605 and downgradient POC wells 607 and 612 southeast of the disposal cell, and well 621 to the northeast (Figures 5.1, 5.2, 5.4, and 5.5 and Table 5.1).

Ground water quality and water level data will also be monitored in background alluvial well 623 and downgradient alluvial well 608 (Figure 5.4). They will be sampled at the same frequency as POC wells until the DOE determines the alluvium has been effectively desaturated (DOE, 1991). They also will be monitored for the same constituents as the POC wells (Sections 5.2.3 and 5.2.4).

5.2.2 Sampling frequency

As described in the RAP, the sampling schedule factors in variables such as background ground water quality, the geochemistry of the tailings pore fluid solution, horizontal and vertical ground water flow rates, possible seasonal variations in ground water, and risk to human health and the environment (DOE, 1991). Ground water levels will be measured before each well is sampled.

Upgradient and downgradient monitor wells were sampled semiannually from 1990 to 1995. Sampling will be conducted annually, beginning in 1996. For consistency, this sampling will be conducted at approximately the same time each year. This frequency may be changed, upon approval from the NRC, based on site-specific conditions and the effectiveness of the remedial action as determined through the ongoing monitoring program (EPA, 1988).

5.2.3 Screening monitoring and exceedance validation

During the established ground water monitoring period (see Section 5.2.2) screening monitoring will be conducted to observe possible changes in ground water quality and to assess compliance with the ground water protection standards. Screening monitoring includes routine water-quality data collection, data evaluation, and possible resampling. It also includes analyzing constituents that are indicative of general water quality and hazardous constituents that are reliable indicators of contamination (Table 5.4). General water quality indicators include pH, electrical conductivity, temperature, alkalinity, oxidation-reduction potential, and major anions and cations (Table 5.4). These data provide general

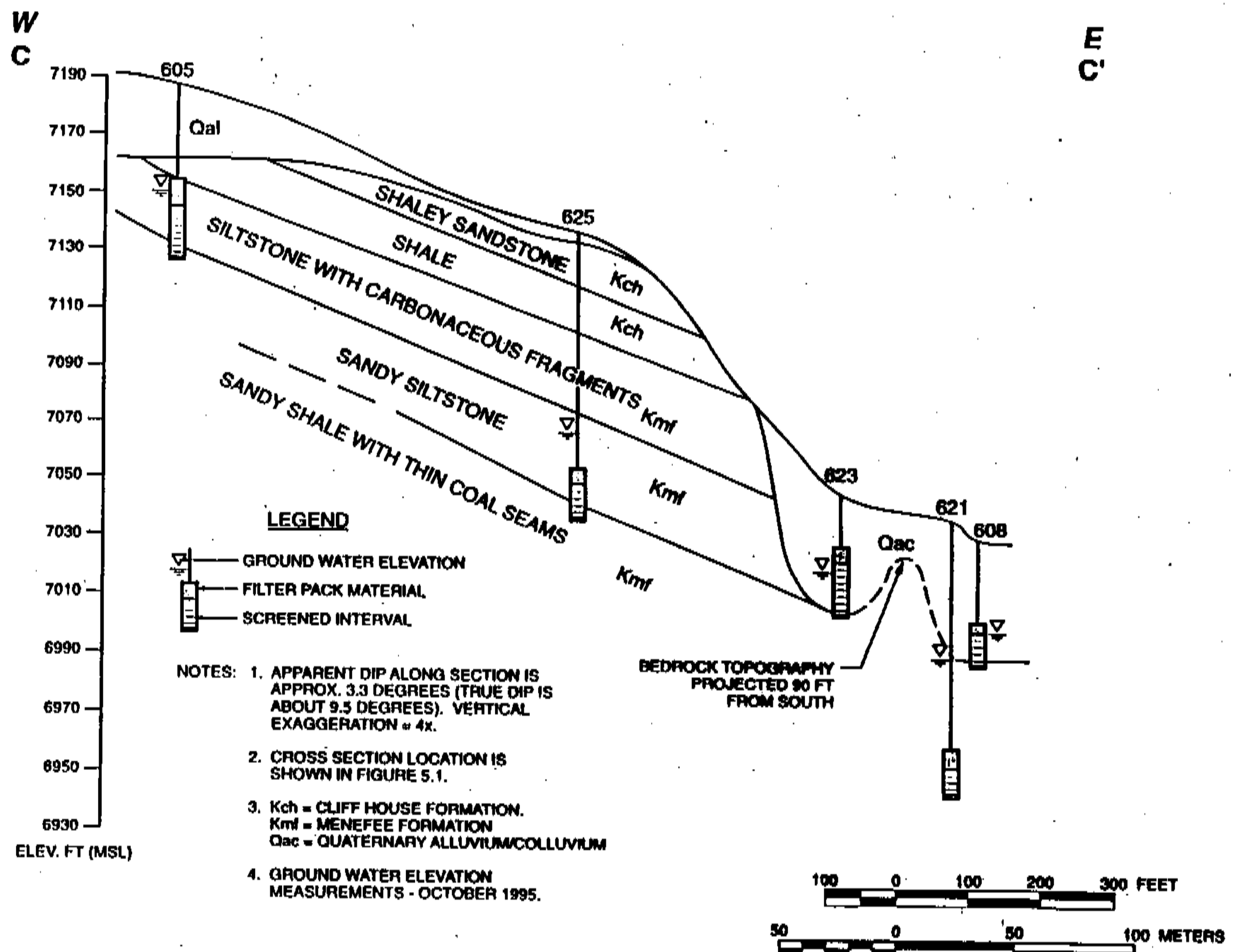
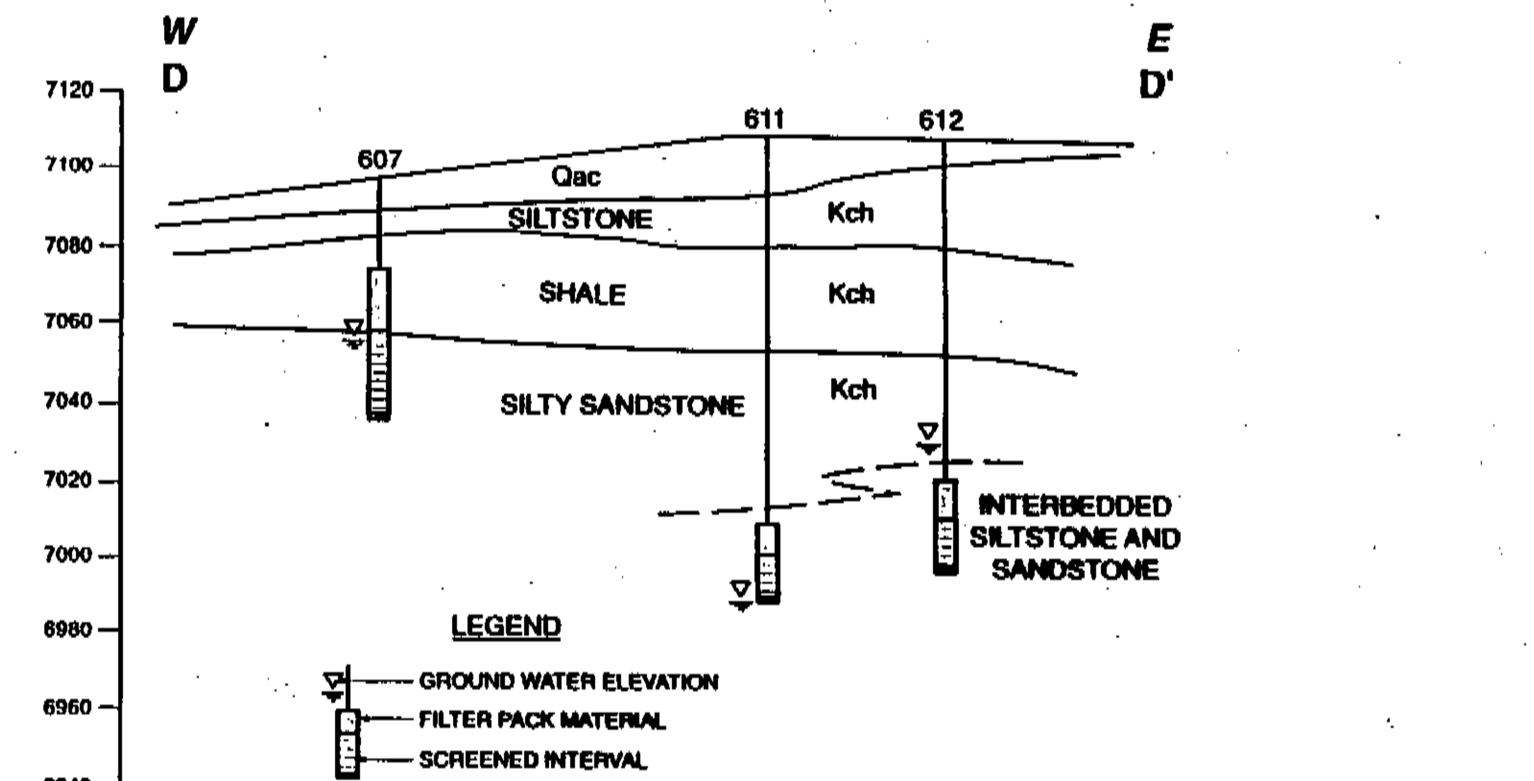


FIGURE 5.4
SCHEMATIC CROSS SECTION C - C'
BODO CANYON, COLORADO, DISPOSAL SITE

MAC: SITE/DUR/LTSP/SCHM-XSEC(C-C')



NOTES:
1. APPARENT DIP ALONG SECTION IS APPROX. 3.3 DEGREES (TRUE DIP IS ABOUT 9.5 DEGREES). VERTICAL EXAGGERATION = 8x.
2. CROSS SECTION LOCATION IS SHOWN IN FIGURE 5.1.
3. Kch = CLIFF HOUSE FORMATION.
Kmf = MENEFEE FORMATION
Qac = QUATERNARY ALLUVIUM/COLLUVIUM
4. GROUND WATER ELEVATION MEASUREMENTS - OCTOBER 1995.

FIGURE 5.5
SCHEMATIC CROSS SECTION D - D'
BODO CANYON, COLORADO, DISPOSAL SITE

MAC: SITE/DUR/I TSP/SCHM-XSEC(D-D')

Table 5.4 Parameters to be measured during screening monitoring at the Bodo Canyon, Colorado, disposal site

Parameter	Proposed maximum concentration
Indicator parameters for detecting ground water contamination	
Molybdenum	0.22[a]
Selenium	0.042[a]
Uranium	0.077[a]
Field parameters for monitoring ground water quality	
Alkalinity	None
Oxidation-reduction potential	None
pH	None
Specific conductivity	None
Temperature	None
Major anions and cations for monitoring ground water quality	
Calcium	None
Chloride	None
Iron	None
Magnesium	None
Manganese	None
Potassium	None
Sodium	None
Sulfate	None
Total dissolved solids	None

[a]All proposed concentration limits are in milligrams per liter and are based upon maximum observed values in background.

information for interpreting potential changes in ground water quality. Screening parameters indicative of contamination are those that 1) are known to be present in the tailings solutions at levels statistically greater than background levels, 2) are present at much higher levels in the tailings solutions than in background, 3) display low variability in background, and 4) are mobile in the ground water environment. The parameters that best meet the first three criteria are arsenic, molybdenum, selenium, uranium, and vanadium. Of these, attenuation batch experiments indicate that subsurface sediments beneath the Bodo Canyon disposal cell will adsorb all the vanadium and most of the arsenic in solution, some selenium and uranium, and a small amount of molybdenum (DOE, 1991). Therefore, molybdenum, selenium, and uranium are the most reliable indicator parameters of ground water contamination at the Bodo Canyon site and will be monitored during screening monitoring.

Exceedances in concentration limits for molybdenum, selenium, or uranium are evaluated on a well-by-well basis. If an MCL listed in Table 5.3 is exceeded, the well will be resampled within 1 year for all screening monitoring parameters (Table 5.4). If the resampling indicates a second exceedance of concentration limits for a parameter, the appropriate steps will be taken, as specified in Section 5.3.2 of the *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE, 1992a).

5.2.4 Evaluative monitoring

When sampling, evaluating, and resampling during screening monitoring does not eliminate the disposal cell as the cause for a water-quality exceedance, evaluative ground water monitoring, additional evaluation, and fieldwork may be required. Evaluative ground water monitoring will involve sampling ground waters from POC and possibly other wells, and analyzing for the entire suite of hazardous constituents identified in Table 5.3 to determine if additional hazardous constituents exceed the proposed concentration limits. Data and fieldwork will be evaluated further to determine if the disposal cell is the cause of an exceedance and if so, its nature and extent. Evaluative monitoring may involve the procedures described in Section 5.3 of the *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE, 1992a).

5.2.5 Indirect monitoring

The DOE will directly monitor ground water at the disposal site (see Section 5.2.1). If screening and evaluative monitoring indicate a change in ground water quality attributable to the disposal cell design, the need for indirect monitoring will be assessed.

If evaluative monitoring indicates the performance of the disposal cell is the cause of an exceedance, it may be necessary to monitor the cover, the tailings, the subsoils, or a combination of components. Some indirect methods that may be applicable to monitoring changes in moisture content in the disposal cell include core sampling to determine gravimetric water content, neutron moisture monitoring, time-domain reflectometry, heat dissipation probes, or cross-hole topography. Any indirect monitoring instrumentation that may be required will be installed in accordance with the appropriate standard operating procedures (SOP) or best management practices. Specific monitoring strategies and instrumentation will be selected in consultation with the NRC.

5.3 CORRECTIVE ACTION

The EPA standards (40 CFR §192.04(c)) require implementation of a corrective action program within 18 months of verification of an established concentration limit exceedance for one or more of the monitored constituents. The goal of the corrective action program is to restore the disposal cell to its design specifications. If corrective action is determined necessary, the DOE will prepare and submit a corrective action plan for NRC review (a copy of this plan also will be transmitted to the CDPHE). The plan will include a monitoring plan to demonstrate the effectiveness of the corrective action, which the DOE will implement after consultation with the NRC and the CDPHE.

5.4 DATA VALIDATION AND QUALITY ASSURANCE

The UMTRA Project Team has established SOPs for monitor well installation and development, water and soil sampling, sample preservation and transport, field procedures, chain of custody samples for laboratory analyses, acquisition protocols, and validating and managing analytical data. All aspects of ground water monitoring are conducted in accordance with these procedures, which are updated regularly to reflect changes in industry standards, best management practices, and guidance from the DOE or EPA. Ground water monitoring at the Bodo Canyon disposal site will remain the responsibility of the DOE until the site comes under the NRC general license. The QA procedures described in this section are consistent with the *RCRA Ground Water Monitoring Technical Enforcement Guidance Document* (EPA, 1986). Sections 5.61 and 5.6.4 in *Guidance for Implementing the UMTRA Project Long-Term Surveillance Program* (DOE, 1992a) summarize standard QA procedures for water sampling and analytical QC and QA and data validation.

5.5 REPORTING

Data and results of the ground water monitoring plan will be described in an evaluation report once every 5 years to the NRC and the state of Colorado. The 5-year report will include the following information:

- Water-quality data, water level data, and other data collected during the reporting period.
- A table comparing water quality indicators to concentration limits.
- A summary of exceedances of concentration limits and the exceedance validation criteria.

- A summary of all resampling, evaluative monitoring, or corrective action required during the reporting period.

- A discussion of significant trends or anomalies in the water quality, other data, or changes in the local hydrologic setting.

- A discussion of new wells or indirect monitoring stations that were installed, including the rationale for their installation, and all completion data.

- All completed field and laboratory forms.

The DOE is responsible for preparing the evaluation reports every 5 years until the GJPO assumes responsibility for a licensed disposal site.

6.0 ANNUAL SITE INSPECTIONS

Inspections of the Bodo Canyon disposal site will be documented in an inspection report to record any changes to the disposal cell and site over time and to identify potential problems before the need for extensive maintenance, repairs, or corrective action. Fundamental to the inspections will be the detection and documentation of progressive change caused by slow-acting natural processes. The findings from these inspections will be compared to the initial baseline conditions to provide a basis for future inspections. The following three types of site inspections should be performed:

- Annual or scheduled site inspections.
- Follow-up inspections.
- Contingency inspections.

Each site inspection must be documented in a report that identifies the findings of the inspection. Copies of the report will be submitted to the NRC and CDPHE and will be placed in the Durango permanent site file. Annual scheduled site inspection reports will be completed and submitted to the NRC within 90 days of the last UMTRA Project site inspection of that calendar year. Follow-up or contingency inspection reports must be submitted to the NRC within 60 days of the NRC's receiving the annual inspection report and within 60 days after any other type of inspection.

6.1 INSPECTION FREQUENCY

The Bodo Canyon disposal site will be inspected annually for the first 5 years after licensing. At the end of the 5-year period, the GJPO will evaluate the need to continue annual inspections, basing its recommendation on an evaluation of the annual reports and any other reports filed for maintenance or unscheduled events. If it is determined that less frequent inspections would be sufficient, the GJPO will modify the LTSP and submit it to the NRC for approval and to the state of Colorado for review. Subsequent inspections will be considered scheduled site inspections.

6.2 INSPECTION TEAM

The inspection team will consist of a chief inspector and one or more assistants. The chief inspector will be a geotechnical engineer, a civil engineer, or an engineering geologist knowledgeable in the processes that could adversely affect the site (e.g., geomorphic agents of change).

When an inspection team is needed for follow-up or assessment inspections, the team will include additional technical experts appropriate to the problems under investigation.

6.3 PREPARATION FOR INSPECTION

Before each inspection, inspectors will complete the following tasks:

- Review the LTSP, the permanent site file, previous site-inspection reports and maps, and all maintenance or corrective action reports.
- Prepare a site-inspection checklist based on previous inspections or repairs, and incorporate any needed modifications.
- Verify and update the names and telephone numbers of all parties with whom access or notification agreements have been executed.
- Verify the DOE 24-hour telephone number and appropriate agency telephone numbers and contacts; arrange to modify the entrance sign, as needed.
- Schedule the site inspection.
- Assemble all equipment needed for the inspection.
- Adjust the Brunton compass's magnetic declination for that of the Durango area (approximately 11 degrees east of true north).
- Notify the NRC, the state of Colorado, and adjacent landowners for their possible attendance at the inspection. Names and addresses of adjacent landowners are available in the Durango permanent site file at the GJPO.

6.4 SITE INSPECTION AND INSPECTION CHECKLIST

The site inspection will cover the disposal site area, the disposal cell, and the immediate off-site areas. All site inspection activities and observations should be recorded and described using the as-built drawings, initial site inspection checklist (Attachment 5), site inspection map, a field notebook, and photographs. Observations and photographic stations should be recorded on the field maps. After the inspection is complete, these maps should be drafted and kept in the Durango permanent site file.

The initial site inspection checklist (Attachment 6) is a guideline for the inspectors. After each inspection is complete, the checklist will be revised to include new information or to delete items that are no longer pertinent. Revisions to the checklist will be documented in the inspection report.

A photographic record of the disposal site inspection must be maintained. Site conditions should be documented by ground photographs to record developing trends and to enable the DOE to evaluate the need for and extent of future activities. If possible, any site feature or condition requiring inspectors to make a written comment, explanation, or description will be photographed. A site inspection photo log will be used to record the photographs (Attachment 5). All features will be photographed and recorded as specified in Section 3.4. The inspectors may determine the number of photographs, the view angles, and lenses used to ensure that sufficient photographs are taken for agency review.

6.4.1 Off-site areas

The area within a maximum 0.25 mi (0.40 km) from the center of the disposal site will be surveyed for evidence of land use changes that indicate increased human activity. New roads or paths, changes in vegetation, and relevant geomorphic features like gullies or aeolian formations, any of which could initiate site-threatening erosion, also will be observed.

6.4.2 On-site areas

The integrity of the disposal cell will be evaluated from a series of transects walked around the perimeter; along the base, crest, and sideslopes; and in and around the diversion channels. Sufficient transects must be walked so that the disposal cell is thoroughly covered and inspected. Diagonal transects of the crest will be made, and the edge of the crest will be walked. Additional transects, at approximately 50-yd (46-m) intervals, will be walked along the sideslopes. Transects along the entire length of each diversion channel will be made to determine if the channels are functioning and can be expected to continue to function as designed.

At a minimum, the site perimeter and site area transects will be monitored for damage to or disturbance of the following features:

- Site perimeter roads.
- Fences, gates, and locks.
- Permanent site-surveillance features.
- Ground water monitor wells.
- Site area vegetation or volunteer plant growth.
- Soil or rock cover (e.g., sedimentation or erosion).

The complete length of transects along the engineered component (diversion channels, cell sideslopes, cell crest, and cover) will be walked and examined for evidence of the following:

- Structural instability resulting from differential settlement, subsidence, cracking, sliding, or creep.

- Erosion as evidenced by developing rills or gullies.

- Sedimentation or debris.

- Rapid rock cover deterioration caused by weathering or erosion.

- Removal of rock or other disposal cell material.

- Seepage.
- Intrusion (inadvertent or deliberate) by humans or animals.
- Volunteer plant growth.

Erosion at the outlet of Drainage Ditch #1 will be monitored and will be inspected annually. The rate at which the erosion is progressing also will be evaluated annually. If through this process it is determined that the erosion is progressing in a manner that could compromise the stability of the disposal cell design, the unscheduled inspection process, as described in Section 7.0, will be initiated.

6.5 MODIFYING PROCESSES

Modifications caused by natural processes may be observed and noted on the topslopes and the lower portions of the sideslopes of the disposal cell. These processes include gullying, headward erosion, cracking, landslides, creep, dissemination, deflation, animal or plant intrusion, and natural events (e.g., tornadoes or earthquakes). Modifications caused by engineered components of the disposal cell most likely will result in plant and animal intrusion.

Inadvertent or casual intrusion by humans or animals may occur because the site is not enclosed by a fence; therefore, evidence of cover removal, vandalism to signs and monuments, or the presence of well-established trails will be described in detail. Continued intrusion may require more active measures to control site access.

If new conditions requiring monitoring or immediate action are discovered during the inspection, the inspection report should describe the problem and when appropriate, recommend follow-up action.

6.6 VEGETATION

6.6.1 Planned vegetation

The top of the disposal cell is a vegetative cover and the uppermost layer consists of a 6-inch (152 mm) rock/soil matrix. A 2.5-ft (0.76 m) rooting medium/frost protection material layer was placed on top of the biointrusion material layer (type A riprap).

The soil was fertilized with a standard commercial grade fertilizer consisting of an nitrogen-phosphorus-potassium ratio of 2 to 1 to 1 or higher. The amount placed averaged 80 pounds per acre (lb/ac) (90 kg/ha). Weed-free straw mulch was placed at 2 tons (4.5 metric tonnes) per acre.

Prior to seed application, the top of the disposal cell was disced to ensure that 6 inches (152 mm) rock/soil matrix was loose and friable, pursuant to seeding specifications. All seeding was accomplished with a range land drill set at 0.2 to 0.4 inches (5 to 10 mm) beneath the surface.

The topslope was planted with the following plant seed poundage:

Smooth brome	4.1 lb/ac (4.6 kg/ha)
Kentucky bluegrass	3.4 lb/ac (3.8 kg/ha)
Western wheatgrass	3.9 lb/ac (4.4 kg/ha)
Blue grama	3.65 lb/ac (4.1 kg/ha)
Galleta	1.95 lb/ac (2.2 kg/ha)
Total	17.0 lb/ac (19.1 kg/ha)

A plant specialist or other qualified person will periodically participate in site inspections. If the inspection does not coincide with the general growing season, the plant specialist may conduct a separate inspection at a more favorable time.

6.6.2 Volunteer plant growth

Volunteer plant growth includes plants growing where none were planned, such as in rock-lined drainage ditches, or unwanted plant species growing on the vegetated topslope of the disposal cell.

A follow-up inspection by a plant specialist may be required if an inspection team reports woody plant species such as big sagebrush growing on the vegetative cover. The growth of woody species on the vegetative cover is expected to minimize after the grass cover becomes established. Woody plants and other unwanted plant species may be eliminated from the cover by selective spraying or mechanical removal.

Based on results of the UMTRA Project plan biointrusion study (DOE, 1995), a volunteer plant root-to-shoot ratio of 1.0 to 1 should be used unless site-specific plant data indicate otherwise. Based on a root-to-shoot ratio of 1.0 to 1, an unwanted plant species must be removed when its shoot height equals or exceeds 3.5 ft (1.1 m) from the base of the plant.

6.7 SITE INSPECTION MAP

A new site inspection map will be prepared after each scheduled inspection using the disposal site map (Plate 1) as a base. This map must include the following:

- Inspection traverses.
- Photograph locations.
- Locations and descriptions of new, anomalous, or unexpected features.
- Features identified during previous inspections for observation or monitoring.
- Inspection date.

6.8 REPORTING REQUIREMENTS

Upon completion of the field inspection, Section D of the initial site inspection checklist (Attachment 6) must be completed and the certification statement must be signed by the GJPO chief inspector. Overlays for the as-built drawings or revised drawings will be developed, noting any potential problems or other site conditions requiring attention. The revised drawings will be labeled with the date and type of site inspection.

All photographs must be logged on a site inspection photo log (Attachment 5). A separate photo log should be completed for each roll of exposed film, with an entry for each photograph. The completed photo logs should be attached to the inspection checklist and paginated accordingly.

Documentary evidence of anomalous, new, or unexpected conditions or situations must be included to record developing trends and to enable the responsible agency to make reasonable decisions concerning follow-up inspections, custodial maintenance and/or repair, and corrective action. Photographs may be considered documentation.

A site inspection report including the following information will be completed after every routine site inspection:

- Narrative of site inspection, including results, conclusions, and recommendations.
- Site inspection checklist and relevant supporting documentation.
- Site inspection map and other drawings, maps, or figures used during the site inspection.
- Inspection photographs and photo log sheet.
- Recommendations for additional follow-up inspections or custodial maintenance and/or repair, if required.
- Follow-up or contingency inspection reports, if required.
- Custodial maintenance and/or repair report and certification, if required.
- Inspection certification.
- Ground water monitoring data and analyses, if applicable.

The inspection report also will detail observed modifying features, describe problems, and provide measurements, photographs, and an assessment of possible impacts. The description of the modifying process will include information such as the following:

- Extent of area affected.
- Number, spacing, length, depth, and width of features (e.g., gullies).
- Related erosional features.
- Patterns of occurrence.

- Plant or animal species present.
- Location and density of volunteer plant growth.

Appendix A, Criterion 12 of 10 CFR Part 40 requires the DOE to submit results of all routine site inspections to the NRC and state of Colorado within 90 days of the last site inspection for each calendar year. A copy of all site inspection reports will be maintained in the Durango permanent site file and a copy of the inspection report will also be sent to the state of Colorado.

7.0 UNSCHEDULED INSPECTIONS

An unscheduled inspection may be triggered by reports or information indicating that site integrity has been or may be compromised.

7.1 FOLLOW-UP INSPECTIONS

Follow-up inspections investigate and quantify specific problems found during a scheduled inspection, ground water sampling event, special study, or other DOE activity. They determine whether processes currently active on or near the site threaten site security or stability, and they evaluate the need for custodial maintenance and/or repair or corrective action.

Follow-up inspections should be made by technical specialists in an appropriate discipline (e.g., a soils scientist or geomorphologist to evaluate erosion processes).

The follow-up inspection begins with an on-site visit to determine the need for definitive tests or studies. Additional visits may be scheduled if more data are needed to draw conclusions and recommend corrective action. If custodial maintenance or repair or corrective action is warranted, the DOE will notify the NRC, the state of Colorado, and the adjacent residents (see Section 9.0).

7.2 CONTINGENCY INSPECTIONS

Contingency inspections are unscheduled inspections ordered by the DOE when it receives outside information indicating that site integrity has been or may be threatened. Events that could trigger contingency inspections include severe vandalism, intrusion by humans or livestock, severe rainstorms, or events such as tornadoes or earthquakes.

The GJPO must submit an assessment of each unusual event to the NRC within 60 days of the initial report that damage or disruption has occurred at the Bodo Canyon disposal site (10 CFR Part 40). The state of Colorado will receive a copy of this report from GJPO. At a minimum, this report must include the following:

- A description of the problem.
- A description of how the inspection was conducted.
- A preliminary assessment of the maintenance or repair or corrective action required.
- Conclusions and recommendations.
- Assessment data, including field and inspection data, and photographs.

- Names and qualifications of the field inspectors.

A copy of the report and all other data and documentation will be maintained in the Durango permanent site file. The annual report to the NRC will include the results of these contingency inspection reports. If appropriate, the annual (or scheduled) Bodo Canyon disposal site inspection report will also contain the results of these inspections.

After reviewing the preliminary inspection/assessment report, the DOE must submit a corrective action plan for NRC approval within the 60-day period required by 10 CFR Part 40. Based on the findings in these reports, the GJPO will complete corrective action, following the guidance for implementing corrective action described in Section 9.0.

8.0 CUSTODIAL MAINTENANCE

Custodial maintenance will be performed as needed at the Bodo Canyon disposal site. Annual site inspections, follow-up inspections, and contingency inspections will determine the need for maintenance or repairs.

8.1 PLANNED MAINTENANCE

Planned maintenance will prevent the growth and establishment of shrubs and trees (principally into the cell) and will prevent erosion. The frequency of the maintenance will be determined after site visits provide adequate information on amount and type of growth.

8.2 UNSCHEDULED MAINTENANCE OR REPAIR

Unscheduled custodial maintenance that may be required at the Bodo Canyon disposal site may include the following:

- Repair or replace gates, entrance signs, perimeter warning signs, and other site features, if necessary.
- Confirm survey monument locations.
- Maintain access road.
- Monitor security of settlement plates and possibly install a lock on each casing.
- Repair cover.
- Reestablish survey control and boundary monuments.
- Remove tumbleweeds or other debris from the diversion channels.
- Repair disposal cell due to animal burrows.
- Repair holding pond drain pipe.
- Reseed, as appropriate.
- Remove volunteer plant growth on the disposal cell or in the diversion channels.

The GJPO will prepare a statement of work (SOW) and purchase order to authorize these kinds of repairs. This SOW will include contractor qualifications.

If problems are identified that may affect the integrity of the disposal cell or compliance with the EPA standards, the NRC must approve the recommended action in advance. The action will be treated as a corrective action.

8.3 CERTIFICATION AND REPORTING REQUIREMENTS

The contractors' annual report to the NRC must include the following information on unscheduled maintenance or repair:

- Summary of work required.
- Work order, purchase order, or SOW.
- Contractor qualifications, if applicable.
- Contractor documentation of work completion.
- DOE certification of work completion.

The DOE will inspect the site, as necessary, and review the report before certifying that all work is completed in accordance with all required specifications. Copies of all records, documentation, and certifications will be included in the Durango permanent site file. Copies of all relevant documentation will be transmitted to the state of Colorado by DOE.

9.0 CORRECTIVE ACTION

If the stability of the disposal cell is threatened, corrective action could include temporary emergency measures. To minimize or avoid their recurrence, the DOE also would evaluate the factors that caused the problem.

The following conditions could require corrective action:

- Surface rupture of the disposal cell (could indicate differential settlement or severe shrinkage of the cover materials).
- Subsidence, sliding, or slope instability on the disposal cell (caused by mass wasting, liquefaction, differential settlement, or other events).
- Development of rills or gullies on the disposal cell.
- Deterioration of the erosion protection rock on the disposal cell or in the drainage ditches.
- Seepage originating from the disposal cell or the toe of cell.
- Gully development on or immediately adjacent to disposal site property that could affect the integrity of the disposal cell.
- Rapid headward cutting of a gully, arroyo, or ravine that threatens the stability of the disposal cell.
- Damage to the cell cover or disposal site property from extreme seismic events, other catastrophic events, or vandalism (e.g., removal of cell construction materials).
- Verification of an excursion during the ground water monitoring program.

When a potential problem is identified, the DOE will notify the NRC and the state of Colorado and will submit an inspection/preliminary assessment report for NRC review no more than 60 days after the problem is identified. The preliminary assessment report will evaluate the problem and will recommend the next step (e.g., immediate action or continued evaluation). After the NRC reviews the report and recommendations, the DOE will develop a corrective action plan for NRC approval. The DOE may combine the inspection and recommendation in one report, depending on the severity of the problem. When the NRC approves the corrective action, the DOE will implement the plan. Figure 9.1 identifies the key elements in the corrective action process.

NRC regulations do not stipulate a time frame for implementing corrective action. However, EPA standards (40 CFR §192.04(c)) require that a corrective action program begin within 18 months after an exceedance in established ground water concentration limits is found. Assessing the extent of the problem and developing a corrective action

NEED FOR CORRECTIVE ACTION IDENTIFIED

- DOCUMENT AND REPORT PROBLEM TO NRC, STATE
- EVALUATE PROBLEM AND PROPOSE A SOLUTION
- DEVELOP CORRECTIVE ACTION PLAN AND NOTIFY NRC AND STATE
- SELECT CONTRACTOR TO PERFORM CORRECTIVE ACTION
- ESTABLISH CONTRACTUAL CONDITIONS FOR PERFORMING CORRECTIVE ACTION AND GUARANTEE CORRECTIVE ACTION WILL BE PERFORMED IN ACCORDANCE WITH CONTRACTUAL AGREEMENTS AND DESIGN SPECIFICATIONS

IMPLEMENTATION

- MONITOR PROGRESS OF CORRECTIVE ACTION
- VERIFY COMPLETION OF CORRECTIVE ACTION

CERTIFICATION

- VERIFY THAT CORRECTIVE ACTION, AS DESIGNED, CORRECTS THE PROBLEM
- ENSURE THAT RECURRENCE OF PROBLEM IS MINIMIZED OR AVOIDED
- CERTIFY COMPLETION OF CORRECTIVE ACTION IN ACCORDANCE WITH 40 CFR PART 192
- SUBMIT CERTIFICATION REPORT TO NRC

MODIFIED FROM DOE, 1992a

FIGURE 9.1
KEY ELEMENTS IN THE CORRECTIVE ACTION PROCESS

plan will not be considered initiation of the corrective action program. Section 9.0 of the LTSP guidance document contains further details on corrective action (DOE, 1992a).

After corrective action is complete, all work completed will be certified in accordance with EPA standards. The NRC will review this certification. A copy of the certification statement will become part of the Durango permanent site file, as will all reports, data, and documentation generated during the corrective action.

10.0 RECORD KEEPING AND REPORTING REQUIREMENTS

The GJPO will maintain a Durango permanent site file containing all the information needed to prepare for and conduct site surveillance. All original deeds, custody agreements, and other property documents will be kept at the DOE Project Team Office, Albuquerque, New Mexico. Copies of these documents also will be maintained in GJPO files. Reports of site-surveillance activities will be maintained in accordance with archival procedures set forth in 41 CFR Part 101, 36 CFR Parts 1220-1238 (Subchapter B, Records Management), and DOE Order 1324.2A, *Record Disposition.*

As required by 10 CFR Part 40, the GJPO will provide an annual report to the NRC and to the state of Colorado documenting the results of the long-term surveillance program and will be added to the Durango permanent site file. The annual reports and supporting documentation in the permanent site file will accomplish the following:

- Document disposal site performance.
- Demonstrate that licensing provisions were met.
- Provide information needed to forecast future site surveillance and monitoring needs.
- Inform the public that site integrity has been maintained.

The results of the ground water monitoring program will be reported once every 5 years to the NRC and the state of Colorado. The UMTRA Project Team will be responsible for preparing these ground water monitoring reports until this responsibility is transferred to the GJPO.

11.0 EMERGENCY NOTIFICATION AND REPORTING

The Bodo Canyon disposal cell was designed to comply with EPA standards (40 CFR Part 192), with minimum maintenance and oversight for a period of 1000 years, or at least 200 years. However, the DOE has requested notification from state, federal, and local agencies of discoveries or reports of any intrusion or damage at the disposal site as well as the occurrence of earthquakes, tornadoes, or floods in the disposal site area to ensure the disposal cell remains in compliance with EPA standards.

The DOE is negotiating notification agreements with the U.S. Geological Survey (USGS) National Earthquake Information Center (Denver, Colorado), the Colorado office of the National Weather Service (NWS), and the La Plata County Sheriff's Department. Copies of these agreements are presented in Attachment 7. The designated point of contact for emergency notification is the GJPO 24-hour telephone line, 970-248-6070. This number is posted on the Bodo Canyon disposal site entrance sign so the public can notify the DOE if problems are discovered.

The DOE has requested that the La Plata County sheriff and the district ranger of the San Juan National Forest, Durango, Colorado, notify the GJPO of any unusual occurrences in the disposal site area that may affect surface or subsurface stability.

The USGS National Earthquake Information Center has agreed to notify the GJPO if a seismic event occurs that fits any of the following descriptions (Attachment 7):

- Any earthquake of magnitude 3.0 or greater, within 0.3 degree (about 20 mi [30 km] at N37.15 latitude and W107.90 longitude) of the site.

- Any earthquake of magnitude 5.0 or greater, within 1.0 degree (about 70 mi [110 km] at N37.15 latitude and W107.90 longitude) of the site.

The DOE will complete an agreement with the Colorado office of the NWS in Denver, Colorado, to notify the GJPO within 8 hours of issuing a flash flood or tornado warning in La Plata County, Colorado. When this agreement is final, the agreement letter will be place in Attachment 7.

12.0 QUALITY ASSURANCE

The GJPO is responsible for developing QA procedures specific to the UMTRA Project long-term surveillance program. The GJPO *Long-Term Surveillance and Maintenance Program Quality Assurance Program Plan* specifies the following requirements (DOE, 1992b):

- Program planning.
- Program inspections, site maintenance, corrective action, and emergency responses.
- Monitoring, if required.
- Qualified, trained personnel.
- Program surveillance and audits.
- Analytical QA.
- Analytical data validation.

All site inspections, monitoring data, records, photographs, maps, and other information related to the LTSP for the Bodo Canyon disposal site are subject to formal and unannounced audits by the DOE or the NRC. Specific QA criteria have been developed for aerial photographs (DOE, 1992b).

Ground water monitoring

Ground water monitoring is required for compliance with 40 CFR Part 192 at the disposal site. The ground water monitoring program will be conducted by the UMTRA Project Team until the site is licensed. Thereafter, site monitoring under the LTSP will be conducted by the GJPO.

QA activities will:

- Identify the organizations involved with ground water monitoring activities and describe their operational, field, laboratory, and QA responsibilities.
- Summarize the data quality objectives (DQO) for ground water restoration and the QA objectives for measuring data: precision, accuracy, representativeness, completeness, and comparability.
- Discuss procedures for field and laboratory analysis of environmental samples and for sample custody, handling, packaging, shipping, and documentation. Laboratory analyses of environmental samples include inorganic, organic, and radiometric constituents; and other chemical, physical, and water-quality parameters.
- Discuss QA in field measurements. The QA procedures for field and laboratory methods appear in applicable SOPs in the UMTRA Technical Assistance Contractor SOP manual

(JEG, n.d.). When an SOP has not been completed for an activity, best management practices (standard industry procedures) will be followed.

- Describe data validation, QA/QC, data reporting calibration frequency, and preventive maintenance procedures for field and laboratory equipment.
- Establish guidance on internal QC checks, data reduction, validation, and reporting requirements for field and laboratory environmental samples.
- Present UMTRA Project system audit procedures and technical, field, and laboratory performance audit procedures.
- Suggest field and laboratory corrective actions and procedures for corrective actions resulting from audits.
- Present QA reporting procedures, outlining reporting requirements to management.
- Describe record keeping.

13.0 PERSONNEL HEALTH AND SAFETY

DOE Order 5480.1B, *Environment, Safety and Health Program for DOE Operations*, establishes personnel health and safety procedures for all DOE operations. After a disposal site is licensed and transferred to the GJPO, the GJPO is responsible for health and safety procedures for GJPO personnel. The GJPO will determine health and safety requirements for its personnel and subcontractors in accordance with applicable orders and federal regulations.

The inspector's health and safety training and certifications; the locations and telephone numbers for emergency medical and law enforcement facilities; and the facility contact 24-hour telephone number will be verified before each site inspection.

Specific safety concerns at the Bodo Canyon disposal site include slip, trip, and fall hazards; animal, snake, and insect bites; heat and cold stress; fire hazards; puncture and cut hazards; and road hazards. Safety equipment should be taken to the site to reduce exposures to identified hazards and to provide first aid to anyone at the site who may need it.

13.1 EMERGENCY MEDICAL AND LAW ENFORCEMENT

Local emergency medical and law enforcement agencies were briefed on the scope of work at the disposal site during the long-term surveillance and maintenance phase. The following 24-hour emergency numbers are pertinent:

- Fire: 911
- Ambulance: 911 or 970-247-4311
- Police/sheriff: 911 or 970-385-2910; 970-247-1157

La Plata County has two hospitals, Mercy Medical Center and La Plata Community, both of which are in Durango. The nearest hospital with ambulance service, a 24-hour emergency room, trauma service, and standard clinical facilities is Mercy Medical Center, approximately 5 mi (8 km) northeast of the Bodo Canyon disposal site (DOE, 1985). Mercy Medical center also has a "life flight" capability for transporting patients to Durango. Directions to the hospital from the site are as follows:

> Take CR 211 to U.S. Highway 160, turn left on U.S. Highway 160 and continue to Park Avenue; turn right on Park Avenue. Mercy Medical Center Hospital is at 375 East Park Avenue.

<u>Location of nearest telephone</u>

The telephone closest to the disposal site is approximately 0.75 mi (1.2 km) to the southwest where the Colorado Division of Wildlife (CDOW) leases or rents a house. The CDOW maintains a shop at this residence and workers are present daily throughout the spring, summer, and fall work seasons. The other nearest residents are in Durango and Wildcat Canyon, northeast and northwest of the site respectively. Because a telephone may not be accessible, a mobile phone must be taken on site visits (DOE, 1985).

13.2 REPORTABLE INCIDENTS

The inspection team should be briefed by the GJPO health and safety officer on potential site hazards and other requirements before site inspections or visits. The GJPO health and safety manager's number is 970-248-6730.

In accordance with DOE Order 5000.3B, any accident, injury, or environmental event (e.g., tornado or flood) occurring during the site inspection is a reportable incident. The condition or event must be reported to the GJPO facility manager or designated contact within 8 hours of the occurrence. The GJPO facility manager's 24-hour telephone number for reporting an incident is 970-248-6070.

14.0 LIST OF CONTRIBUTORS

The following individuals contributed to the preparation of this LTSP.

Name	Contribution
C. Saumur	Document coordinator
D. Tarbox, R. Heydenburg	Hydrogeology
G. Hartmann, R. Meyers	Engineering
P. Martinez	Real estate
R. Neri Zagal, J. Lommler, A. Holm. S. Cox	Document review
S. Cox, E. Artiglia	Site management, document review
C. Yancey	Peer review
J. Lommler	Engineering review
L. Keith, C. Slosberg	Text processing
L. Wagner	Graphic design
D. Tamez, A. Cree, D. Thalley	Technical editing, document production, coordination

15.0 REFERENCES

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MK-F (Morrison Knudsen-Ferguson), 1991. "Durango Draft Completion Report," Contract No. DE-AC04-83AL18796, prepared by Morrison Knudsen-Ferguson for the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

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CODE OF FEDERAL REGULATIONS

10 CFR Part 40, *Domestic Licensing of Source Material*, U.S. Nuclear Regulatory Commission.

36 CFR Parts 1220-1238, *National Archives and Records*, "Subchapter B, Records Management," National Archives and Records Administration.

40 CFR Part 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings*, U.S. Environmental Protection Agency.

41 CFR Part 101, *Federal Property Management Regulations*, General Services Administration.

DOE ORDERS

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FEDERAL REGISTER

60 FR 2854, *Groundwater Standards for Remedial Actions at Inactive Uranium Processing Sites,* final rule, 11 January 1995.

UNITED STATE CODE

42 USC §7901 *et seq.*, *Uranium Mill Tailings Radiation Control Act*, 8 November 1978.

42 USC §7914 *et seq.*, *Acquisition and Disposition of Lands and Materials*, 8 November 1978.

ATTACHMENT 1

NRC CONCURRENCE AND LICENSING DOCUMENTATION

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 18, 1996

Mr. Richard Sena, Acting Director
Environmental Restoration Division
Uranium Mill Tailings Remedial
Action Project
U.S. Department of Energy
2155 Louisiana NE, Suite 4000
Albuquerque, NM 87110

SUBJECT: FINAL COMPLETION REVIEW REPORT FOR THE DURANGO, COLORADO, URANIUM MILL TAILINGS REMEDIAL ACTION PROJECT SITE

Dear Mr. Sena:

The U.S. Nuclear Regulatory Commission staff has completed its review of the U.S. Department of Energy's (DOE's) Final Completion Report for the Uranium Mill Tailings Remedial Action Project inactive uranium mill tailings site at Durango, Colorado, submitted on October, 16, 1995. The review considerd pertintent documents associated with this site including revised Completion Report pages transmitted by letters dated November 9, 1995, May 9, 1996, and May 23, 1996. The NRC staff's review of the Completion Report is documented in the final Durango Completion Review Report (Enclosure 1), which discusses the staff's evaluation of the completed remedial action.

Based on its review of the Completion Report, NRC staff concurs that DOE has performed remedial action at the Durango site in accordance with the approved plans and specifications, with the exception of the selection and performance of a groundwater cleanup program. DOE, with NRC approval, has deferred this aspect of the remedial action to a separate groundwater restoration program. The signed DOE Certification Summary providing official NRC concurrence in completion of the Durango remedial action (other than groundwater cleanup), is enclosed.

If you have any questions concerning this subject letter or the enclosures, please contact the NRC Project Manager for the Durango site, Janet Lambert, at (301) 415-6710.

Sincerely,

Joseph J. Holonich

Joseph J. Holonich, Chief
Uranium Recovery Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

cc: J. Evett, DOE Alb
S. Hamp, DOE Alb
E. Artiglia, TAC Alb

CERTIFICATION SUMMARY
for the
Durango, Colorado, Disposal Site

The Environmental Restoration Division Acting Director and the Contracting Officer for the U.S. Department of Energy certify the Durango, Colorado, processing and disposal sites are complete and meet all design criteria, technical specifications, and the surface Remedial Action Plan required under Public Law 95-604. The undersigned request that the U.S. Nuclear Regulatory Commission concur in this certification.

Juan D. Williams
Contracting Officer
Major Programs Team
Field Management Branch
Contracts and Procurement Division

DATE: 10-16-95

Richard F. Sena
Acting Director
Environmental Restoration Division

DATE: 10-16-95

The U.S. Nuclear Regulatory Commission's Chief of High-Level Waste and Uranium Recovery Projects Branch hereby concurs with the U.S. Department of Energy's completion of surface remedial action at the Durango, Colorado, processing and disposal sites.

Joseph J. Holonich, Chief
JJH ~~High-Level Waste and~~ Uranium Recovery
~~Projects~~ Branch
Division of Waste Management
Office of Nuclear Materials Safety
and Safeguards
U.S. Nuclear Regulatory Commission

DATE: June 19, 1996

ATTACHMENT 2

SITE OWNERSHIP/CUSTODY DOCUMENTATION

REAL ESTATE DOCUMENTATION
LONG-TERM SURVEILLANCE PLAN
BODO CANYON DISPOSAL SITE
DURANGO, COLORADO

GENERAL

State acquisition of the Bodo Canyon disposal site was completed by the Remedial Program Management Unit of the Colorado Department of Public Health and Environment. The Bodo Canyon disposal site acquired by the state contains approximately 120.6 acres (ac) (48.8 hectares [ha]). The site was acquired in two tracts. The first tract, Tract 101, was acquired from the Colorado Department of Natural Resources, Division of Wildlife, through a quit claim deed dated 4 August 1987. This tract consisted of 38.7 ac (15.7 ha). The second tract, Tract 102, was acquired from the state land board and consisted of 81.36 ac (32.93 ha). The acquisition was effected through a real estate exchange agreement dated 15 May 1990.

The U.S. Department of Energy (DOE) has requested that the state of Colorado forward final deeds and supporting documentation for the transfer of the Bodo Canyon uranium mill tailings disposal site to the federal government pursuant to 42 USC §7914(f) of the Uranium Mill Tailings Radiation Control Act of 1978.

On 20 October 1993, the state of Colorado forwarded the documentation to the U.S. Army Corps of Engineers (USACE) for review. The USACE has since determined that the documentation is complete and that no encumbrances are on the deeds. The USACE is waiting for a letter from the DOE before completing the title transfer. The letter will be based on NRC concurrence with DOE certification that the site meets the EPA cleanup standards.

LEGAL DESCRIPTIONS

Disposal site/boundaries

(a) Tract 101

A Tract of land in the East One-half (E 1/2) of Section Thirty-six, (Sec. 36), La Plata County, state of Colorado, being more particularly described as follows:

Beginning at a point on the east line of said Sec. 36 of the New Mexico Principal Meridian, which point bears South 00° 39' 08" East a distance of 130.00 feet from the Northwest corner of Section Thirty-one (Sec. 31), Township Thirty-four and One-half North (T34 1/2 N), Range Nine West (R9W);

Thence West a distance of 2075.00 feet to a point;

Thence South a distance of 1700.00 feet to a point;

Thence East a distance of 2094.35 feet to the east line of said Sec. 36;

Thence North 00° 39' 08" West a distance of 1700.00 feet to the point of beginning; said tract contains 81.36 acres (32.93 ha), more or less.

(b) Tract 102

A Tract of land in Section Thirty-one (Sec. 31), Township Thirty-four and one half North (T34 1/2 N), Range Nine West (R9W), of the NMPM in La Plata County, state of Colorado being more particularly described as follows:

Beginning at a point on the West line of said Section 31, whence the Northwest corner of said Section 31 bears North 00° 39' 08" West a distance of 130.00 feet;
Thence East a distance of 1,000.00 feet;
Thence South a distance of 1,700.00 feet;
Thence West a distance of 980.65 feet to the West line of said Section 31;
Thence North 00° 39' 08" West a distance of 1,700.11 feet to the point of beginning; said Tract contains 38.7 acres (15.70 ha) more or less.

Also: Including all rights presently owned by the Grantor to any and all minerals, ore and metals of any kind and character and all coal, asphaltum, oil, gas, geothermal resources or other substances in, on or under the above described tract being conveyed.

(2) Filed: Deed recordation data will be provided once transfer has been completed. Deeds not yet recorded.

REPOSITORY

Real estate correspondence and related documents are maintained and filed by the Property Management Branch, Property and Administrative Services Division, Albuquerque Operations Office, under the supervision of Corville J. Nohava, (505) 845-6450.

REFERENCE

42 USC §7901 *et seq., Uranium Mill Tailings Radiation Control Act*, 8 November 1978.

ATTACHMENT 3

BODO CANYON TOE DRAIN CLOSURE AND HOLDING POND DECOMMISSIONING PLAN

TABLE OF CONTENTS

Section **Page**

LIST OF FIGURES

LIST OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EPA	U.S. Environmental Protection Agency
MCL	maximum concentration limit
NRC	U.S. Nuclear Regulatory Commission
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RRM	residual radioactive material
VP	vicinity property

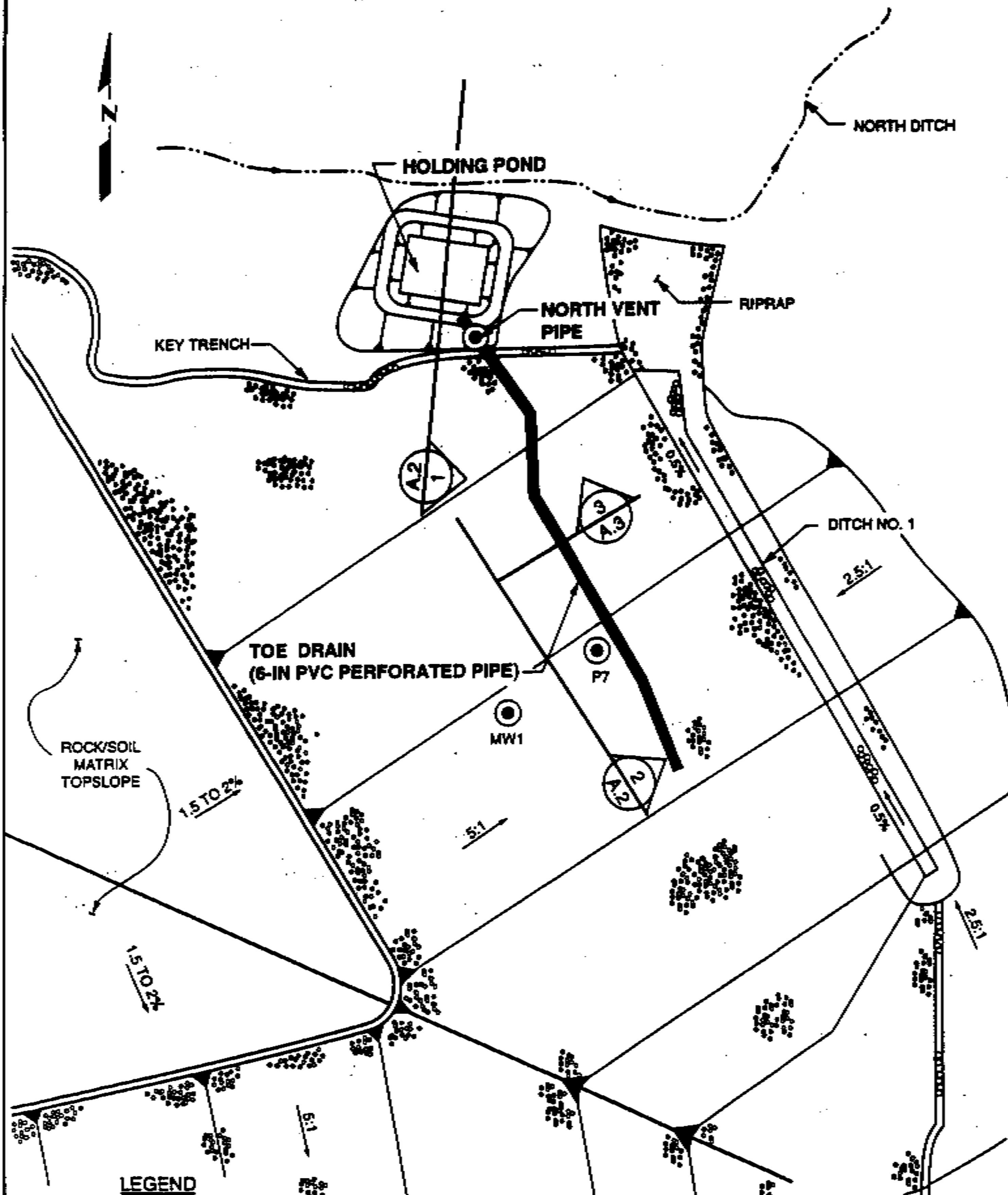
1.0 INTRODUCTION

Excess pore water from the tailings material has been collected in a toe drain collection system along the eastern slope of the Bodo Canyon disposal cell (disposal site) and has been draining into a 320,000-gallon (gal) (1,200,000-liter [L]) lined holding pond since November 1989 (Figures A3.1 through A3.4). To proceed with licensing the disposal site, the holding pond closure plan must be documented so that when the administrative decision is made to permanently shut off the toe drain, the decommissioning plan may be followed to allow for removing of the contaminated sludge, liner, and contaminated soil to a suitable repository. The decision will be based upon the observation that sufficient water has been drained from the cell to preclude the possibility that the seeps could reappear or produce unacceptable hydrostatic pressures on the slope of the cell. Once this has been established, the toe drain system will be discontinued. A flow chart of the toe drain closure and holding pond decommissioning plan is shown in Figure A3.5. All regulatory and permitting requirements in effect at the time the closure plan is initiated will be applied to the removal of contaminated materials and closure of the site. After the contaminated materials are removed, the toe drain will be permanently sealed, the site will be regraded, and suitable erosion protection measures will be incorporated into the existing design features of the disposal cell.

BACKGROUND

The toe drain and holding pond were installed after extensive seepage appeared on the eastern slope of the disposal cell during construction in the fall of 1988. The toe drain enabled cell closure to proceed by allowing correct placement of the clay cover on unsaturated tailings in the area where the seep appeared. This procedure also prevented hydrostatic pressure from developing against the inside surface of the sideslope. Other alternatives for dewatering the cell were considered, such as deep wells, an ejector system, and horizontal drains. The toe drain was selected because it allowed the disposal cell construction to proceed with minimal effect on the original completion schedule.

Because the seep initially appeared just above the top of the low-permeability liner (at an elevation of 7052 feet (ft) (2149 meters [m]), just above the top of the clean fill dike, the tailings were thought to be saturated from the base of the cell to the top of the clean fill dike. The source of the water likely resulted from the significant volumes of water used for dust control (80,000 gal [300,000 L] per day) and the water added for compaction requirements. A phreatic surface was recorded in monitor wells that were installed in the tailings material. Assuming full saturation to the base of the cell, 15 million gal (57 million L) of drainable water were estimated to reside in the cell. However, when test pits were excavated to construct the toe drain, ponded water was observed on a vicinity property (VP) material low-permeability layer. Extensive areas below the VP layer were not saturated. The perched zone of saturation above the VP layer also was indicated by the flow rates recorded from the dewatering wells, which were installed to construct the trench and to dewater the cell as much as possible. The flow rates were directly proportional to a saturated thickness corresponding to the thickness between the top of the VP layer and the measured phreatic surface. Additional lab testing of soil samples



LEGEND

DATA LOGGER LOCATIONS

PVC POLYVINYL CHLORIDE

RIPRAP

FIGURE A3.1
TOE DRAIN AND HOLDING POND
BODO CANYON, COLORADO, DISPOSAL SITE

NOT TO SCALE

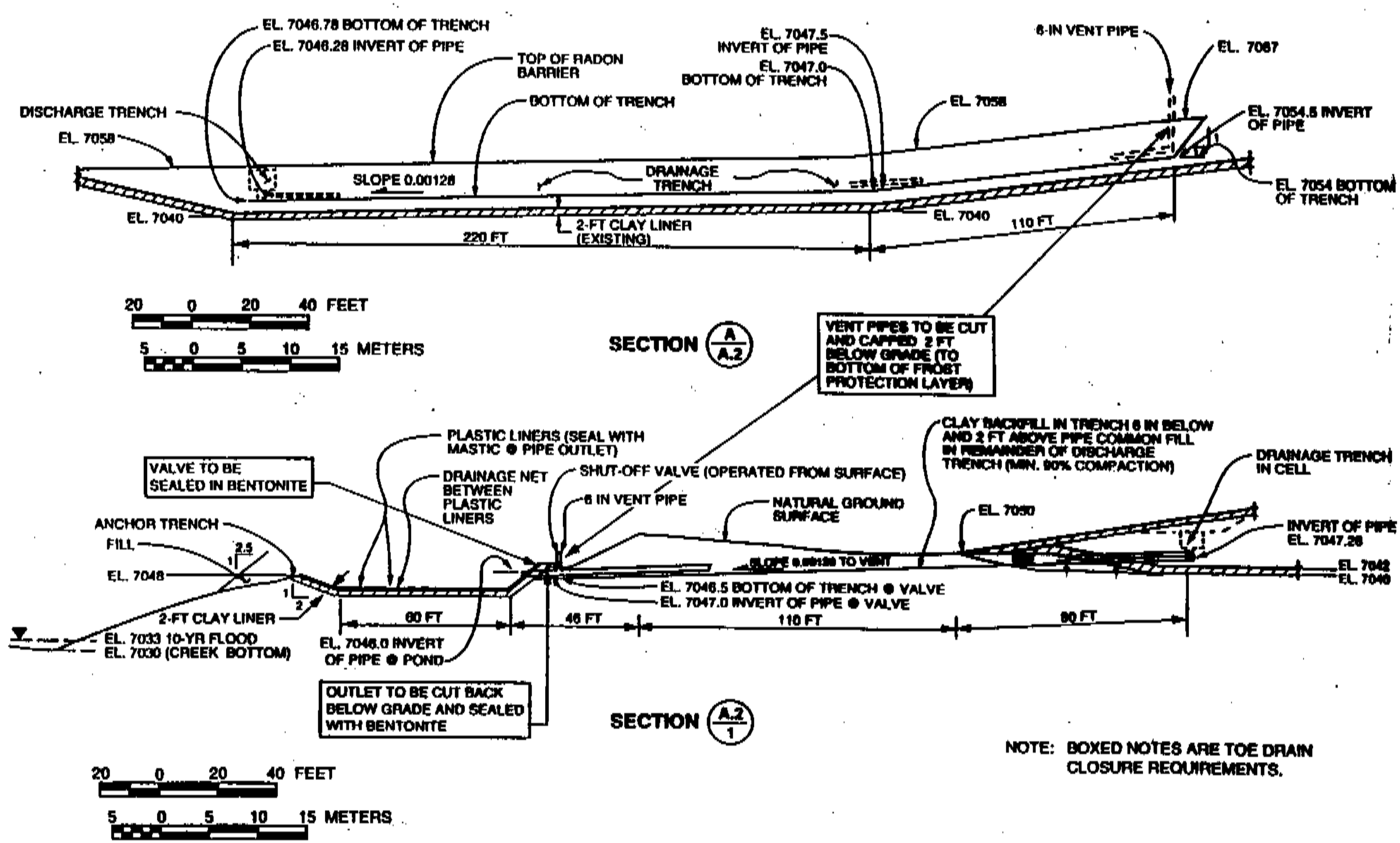


FIGURE A3.2
CROSS SECTION OF DISCHARGE TRENCH AND HOLDING POND
BODO CANYON, COLORADO, SITE

MAC: SITE/DUR/LTSP/XSECT1

ATTACHMENT #3

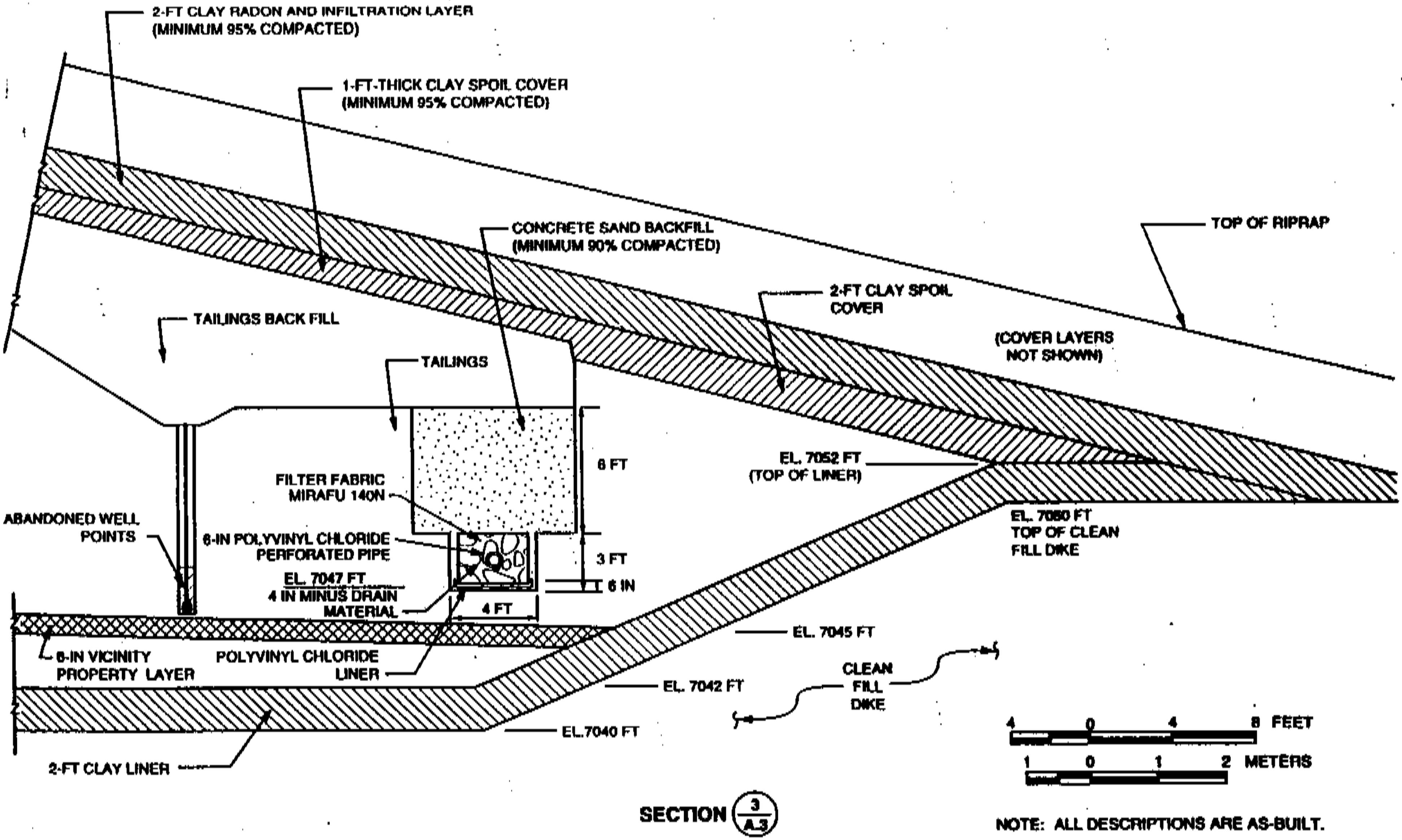
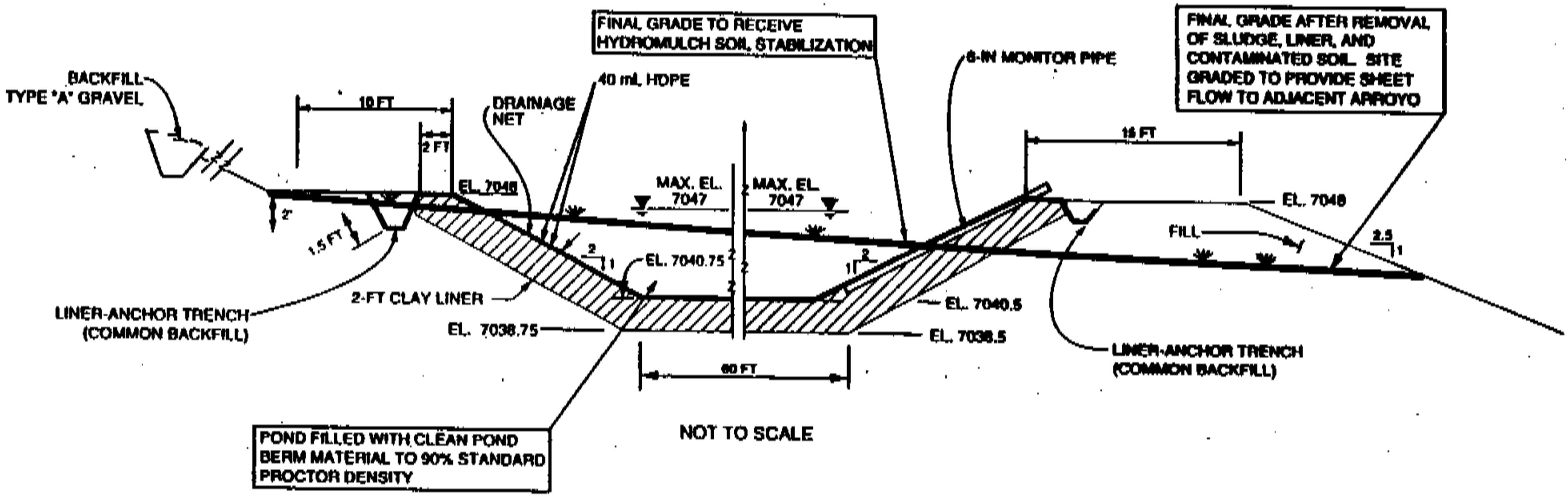


FIGURE A3.3
TYPICAL CROSS SECTION OF DRAINAGE TRENCH
BODO CANYON, COLORADO, SITE

MAC: SITE/DUR/LTSP/TYPSECDRN2



NOTE: BOXED NOTES ARE HOLDING POND DECOMMISSIONING PLAN REQUIREMENTS.

LEGEND

HDPE	HIGH-DENSITY POLYETHYLENE
mL	MILLILITER
▼	WATER LEVEL

FIGURE A3.4
HOLDING POND - SITE RESTORATION
BODO CANYON, COLORADO, SITE

MAC: SITE/DUR/LTSP/XSECT2

ATTACHMENT #3

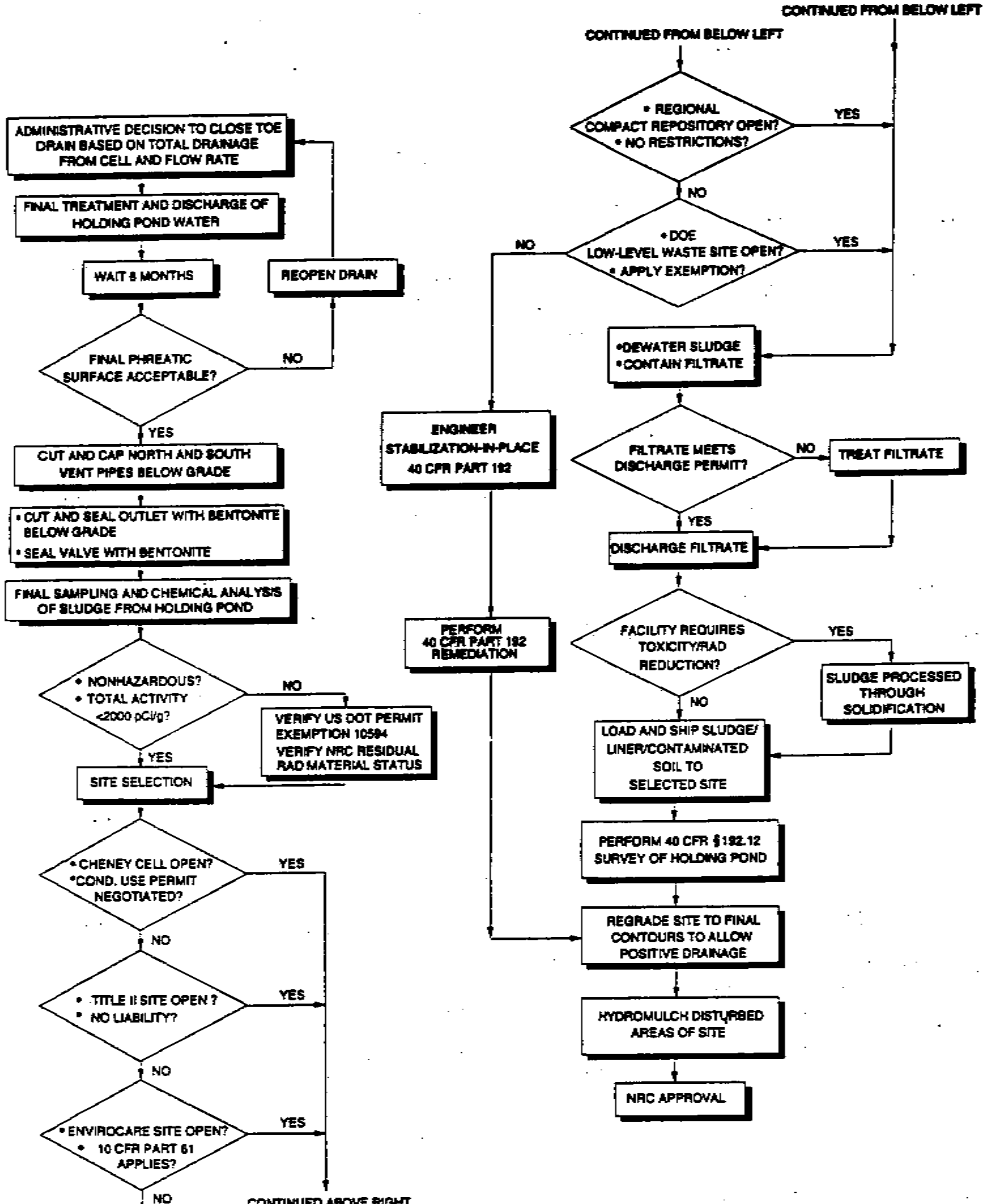


FIGURE A3.5
TOE DRAIN CLOSURE AND HOLDING POND DECOMMISSIONING FLOW CHART, BODO CANYON, COLORADO, SITE

above and below the VP layer confirmed the perched zone of saturation within the tailings (DOE, 1991).

The VP layer creating the perched condition was installed at the end of the 1987 construction season as a protective cover through the winter shutdown. The average thickness of the layer was 6 inches (15 centimeters [cm]) and consisted primarily of clay. The extent of the VP layer was estimated from an aerial photo taken during the winter shutdown and from quality assurance records made during the fall of 1987. The VP layer dipped northeast from a maximum elevation of 7070 ft (2150 m) to an elevation of 7045 ft (2147 m) at the clean fill dike. The VP layer was encountered along the entire length of the excavation for the toe drain, from north to south (DOE, 1991).

The perched zone of saturation significantly reduced the estimated volume of drainable water within the pile. Using a saturated thickness from the top of the VP layer to the recorded phreatic surface, an estimated 2 million gal (7,600,000 L) of drainable water remained in the cell. A 17-well dewatering system pumped an estimated 630,000 gal (2,400,000 L) of water during the summer and fall of 1989. Well points used to dewater the excavation for the toe drain trench had removed another 100,000 gal (380,000 L). Thus, once the toe drain was operational, an estimated 1,300,000 gal (4,900,000 L) of pore water would potentially drain from the cell if the drain remained open indefinitely (DOE, 1991). The flow rate from the toe drain has been recorded at fairly regular intervals since its opening in November 1989, and approximately 2 million gal (7,600,000 L) of pore water were treated and discharged from the holding pond through the fall of 1993. In addition, an estimated 325,000 gal (1,230,000 L) of pore water evaporated from the pond, based on an evaporation rate of 42 inches (107 cm) per year and an average precipitation rate of 19 inches (48 cm) per year. Therefore, an estimated 2,300,000 gal (8,700,000 L) of water were drained from the cell up to the fall of 1993.

Currently, drained water is retained in the holding pond and is treated approximately every 6 months before discharge into the north arroyo, some 150 yards (140 m) northeast of the site. Lime is added to the water to precipitate the dissolved solids, metals, and uranium, which then settle out as a sludge on the bottom of the pond. Sulfuric acid is applied to the remaining water, to return the pond to an acceptable pH balance. Pond samples are tested to ensure the treated water is within National Pollutant Discharge Elimination System discharge limits. When the laboratory report shows the water is safe for discharge, the water is siphoned into the north arroyo through a polyvinyl chloride (PVC) outlet line.

Models developed using the drainage properties of the tailings and conditions at the site predicted flow from the toe drain would continue for a period of up to 10 years from the initial opening of the drain (TAC, 1990).

In 1992 a review of the records for water from the toe drain revealed that more water had drained out of the pile than had been predicted in 1989. A new calculation was performed in 1994 to determine the original quantity of drainable water in the pile. This calculation found the original estimate of 2 million gal (8 million L) of drainable water calculated in 1989 was 2 to 4 million gal (8 to 15 million L) too low, because the original estimate did not include drainable water from the unsaturated soil layers. Consequently an estimated 2 to 4 million gal (8 to 15 million L) of water remained to be drained as of the fall of 1994.

In 1993 and 1994 the Technical Assistance Contractor (TAC) modeled the cell drainage and reevaluated the maximum height to which the perched water could rise without causing seeps from the cell and without affecting slope stability. This analysis revealed that a perched water elevation of 7055 ft (2150 m) above mean sea level (MSL) would be acceptable.

In 1993 the TAC installed data loggers in monitor wells close to the toe drain trench and the drain to observe the rate of rise in the water level in the tailings when the toe drain was shut off. The data loggers also were used to determine if there was any seasonal recharge through the pile cover. Water level changes monitored in the toe drain with the drain shut off showed no seasonal change in water levels attributable to water entering the pile from the cover. In addition pile settlement plate elevations indicated that only very low settlements have occurred and that there is no concern about cover cracking as a result of differential settlement. These low measured cover settlements and the 1994 estimate of drainable water should alleviate concerns that transient flow from the toe drain indicates poor pile performance.

Finally a third model run was made in 1995 using the 1994 drainable water quantities. This model indicated the toe drain should be operated until 1997 to achieve an equilibrium water level at 7055 ft (2150 m) elevation. Equilibration will allow the toe drain to be closed permanently.

2.0 CONTAMINANT CHARACTERIZATION

Contaminant characterization of the precipitated sludge and pond water is of primary importance to the decision-making process for decommissioning the holding pond. Samples were analyzed from the pond water, sludge retained on a Buchner funnel, and filtrate from sludge dewatering. Reviewing the chemical analyses of the sludge and of the pond water samples resulted in the following conclusions (TAC, 1992):

- The sludge would not be classified as a Resource Conservation and Recovery Act (RCRA) hazardous waste because no samples exceeded the maximum toxicity concentration levels based on the toxicity characteristic leaching procedure (42 USC §6901 *et seq.*).

- The mean total radioactivity of the sludge samples was less than the 2000 picocuries per gram (pCi/g) limit that classifies shipments as radioactive hazardous material according to U.S. Department of Transportation (DOT) hazardous material regulations.

- Concentrations of organic constituents were below detection limits.

- Inorganic constituents were within the holding pond discharge limitations in the discharge permit issued by the state of Colorado.

- The maximum concentration limits (MCL) of U.S. Environmental Protection Agency (EPA) ground water standards were exceeded for molybdenum, selenium, uranium, and gross alpha from the filtrate and pond water sampled (40 CFR Part 192). Arsenic exceeded its MCL in some of the filtrate samples. Sulfate was high in both waters, with concentrations greater than 1600 milligrams per liter (mg/L).

- The high sulfide concentrations indicate the oxidation-reduction potential is reducing. Thus, if the sludge became oxidized, the molybdenum, uranium, and vanadium could be mobilized with solution concentrations exceeding those measured from the samples themselves.

This characterization has been consistent for two different sampling periods (TAC, 1992; MK-E, 1993). The potential for significant changes in the contaminant characterization of the sludge and holding pond water is small, except for possible seasonal fluctuations caused by equilibrium conditions predominant over time, and the flow continues to decrease. However, a final sampling round will be conducted before pond closure. The sludge will be analyzed to confirm that the characteristics have not changed, and to ensure that the proper administrative and regulatory decisions are made for final disposal.

These characteristics will allow shipping the sludge and holding pond liner in bulk, without triggering DOT hazardous material restrictions. The current DOT Exemption 10594 for shipping low-level radioactive mill tailings and materials contaminated with radionuclides from these tailings would apply to sludges that exceed 2000 pCi/g. Further, the U.S. Nuclear Regulatory Commission (NRC) classifies the sludge as a residual radioactive material (RRM), which requires that the sludge be disposed of in a facility that provides perpetual care under long-term licensing agreements with the NRC (MK-E, 1991). Title I and Title II sites licensed by the NRC under 10 CFR Part 40 qualify as facilities that may receive the sludge for permanent disposal. U.S. Department of Energy (DOE) Order 5820.2A, *Radioactive Waste Management*, allows small quantities of RRM to be disposed of as low-level radioactive waste.

2.1 SLUDGE DISPOSAL ALTERNATIVES

Various alternatives may be available for disposal of the sludge, liner, and contaminated soil when the administrative decision is made to decommission the toe drain and holding pond. At that time, the following locations most probably will be available to receive the holding pond contaminated materials:

- A Uranium Mill Tailings Remedial Action (UMTRA) Project disposal cell still open.
- A Title II site still open.
- A commercial radioactive waste disposal facility (such as the Envirocare site at Clive, Utah).
- A regional compact repository licensed under 10 CFR Part 61.
- A DOE low-level waste disposal site.
- 40 CFR Part 192 remediation.

Each option is discussed below, with the conditions and restrictions that may be in effect when the toe drain and holding pond are decommissioned.

2.1.1 UMTRA Project disposal cell

The Cheney disposal cell near Grand Junction, Colorado, is capable of receiving 500,000 cubic yards (yd^3) (380,000 cubic meters [m^3]) of VP materials until at least 1998. This is the UMTRA Project site most likely to be open to receive the Bodo Canyon sludge. All other sites in Colorado are scheduled for completion well before closure of the Cheney disposal cell. One possible restriction to using the Cheney cell as the repository for the sludge is the Mesa County Conditional Use Permit, which precludes the disposal of out-of-county material. Negotiations would need to be initiated with Mesa County to gain an exclusion to this restriction for the Bodo Canyon contaminated materials.

2.1.2 Title II sites

If the Cheney disposal cell or any other UMTRA Project disposal cell cannot receive the sludge, Title II sites may be acceptable repositories because they are perpetual care facilities licensed under 10 CFR Part 40. The closest site is the Union Carbide Corporation (Umetco) site at Uravan, Colorado. However, potential Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) liability concerns must be resolved before this site could be pursued as the receptor of the sludge (42 USC §9601 *et seq.*). Other Title II sites without potential CERCLA liability may be more likely options; however, transportation costs would be higher.

2.1.3 Commercial radioactive waste disposal facility

The Envirocare site at Clive, Utah, may qualify as an acceptable repository for the Bodo Canyon contaminated materials. Along with other commercial radioactive waste disposal facilities licensed under 10 CFR Part 61, the Envirocare site has the necessary long-term requirements for stability and institutional controls. This site can accept radioactive materials with less than 2000 pCi/g; the mean total activity of the sludge is within this limit, as indicated by the most recent sampling and analysis activities (TAC, 1992; MK-E, 1993).

2.1.4 Regional compact repository

Except for Envirocare, commercial disposal facilities currently in operation are likely to be closed and replaced by regional compact repositories by the time the toe drain and holding pond are decommissioned. These facilities are being developed to accept civilian low-level radioactive waste and may be operating by the time the holding pond is decommissioned. Because none of these sites is operational, potential waste acceptance restrictions are not known. Minimum requirements the NRC identified for these sites in 10 CFR §61.56 would not preclude the acceptance of contaminated materials from the holding pond as it has been characterized to date.

2.1.5 DOE low-level waste disposal site

The Nevada Test Site or the Idaho National Engineering Laboratory are DOE facilities that may receive low-level radioactive waste from the holding pond. DOE Order 5820.2A identifies the minimum waste acceptance criteria for DOE low-level waste disposal sites. Individual DOE facilities and state regulators may have site-specific acceptance criteria that would require the UMTRA Project to apply for a special exemption. For example, the Nevada Test Site accepts only radioactive and mixed waste from DOE defense programs.

2.1.6 40 CFR Part 192 remediation

If none of the alternative sites above is able to receive the sludge and contaminated materials from the holding pond, an on-site remediation plan will be implemented under EPA regulations (40 CFR Part 192). A small containment cell that meets these standards will be engineered and constructed within the boundary of the disposal site, so that long-term surveillance of the small cell is conducted in conjunction with long-term surveillance of the main disposal cell.

2.2 PREPARING SLUDGE FOR SHIPMENT

The volume of sludge to be shipped is dependent on the duration and rate at which the pore water continues to drain from the cell. An estimated 44 yd^3 (34 m^3) of sludge (of which 85 to 90 percent is water) was precipitated out during the first year of operation (MK-E, 1991). Because the toe drain flow rate is decreasing, it may be reasonable to estimate that 40 yd^3 (30 m^3) of sludge is deposited per year over the service life of the holding pond. Assuming a 10-year total operating life of the pond, approximately 400 yd^3 (300 m^3) of sludge could be dewatered and shipped to the selected permanent repository.

The sludge will be dewatered on the site. The filtrate water would be contained and analyzed for compliance with the discharge permit in effect at that time. If necessary, the filtrate will be retreated before discharge into the arroyo. Assuming the volume of the dried sludge is 30 percent of the wet volume, approximately 120 yd^3 (90 m^3) of dried sludge could be transported at the end of 10 years.

The dewatered sludge will be reanalyzed for toxicity characteristics and for total activity to confirm its suitability for shipment as a nonhazardous material and to maintain its RRM status. Analysis of the dewatered sludge is not expected to show significant variation from analyses performed to date.

If the sludge is classified as expected, the dried sludge can be hauled to the permanent repository. The high density polyethylene liner will be cut into sections that may be hauled with the sludge. After the liner is removed from the holding basin, the exposed subgrade soil will be inspected for any signs of leakage and spillage. Upon removal and shipment of the contaminated material, a radiological verification survey of the holding pond area will be conducted to confirm removal of contamination to within the allowable RRM standard as defined in 40 CFR §192.12. Soil samples will also be analyzed for toxicity characteristic of organic and inorganic contaminants. Any soil that does not meet the standards for activity or toxicity will be removed and shipped to a designated permanent repository site.

If the facility accepting the sludge requires toxicity and/or radiological reduction, the sludge could be processed through solidification technology using Portland cement or fly ash. The high-efficiency solids contractor will produce a uniform mixture of cement, sludge, and water that will be transferred to a permanent mold for curing the mass. The mold also will serve as the container for shipment. After the mixture sets up, it will be tested for physical integrity and chemical stability before shipment.

2.3 TRANSPORTING SLUDGE AND CONTAMINATED MATERIALS

Current characterization data indicate the sludge and related contaminated material will not need to be shipped as hazardous material. The mean total activity of the dried or processed sludge and related materials is expected to be less than 2000 pCi/g. As transported material it will not require classification as radioactive hazardous material, according to DOT regulations, and restrictions or special precautions will not be required to transport the contaminated material from the holding pond, except as covered by normal federal and state transportation regulations. If the activity of the sludge and contaminated materials exceeds 2000 pCi/g, they will be shipped under DOT Exemption 10594 for shipping low-level radioactive mill tailings, as material contaminated with radionuclides from the tailings.

The contaminated materials will be hauled in vehicles that prevent spillage along the haul route. Haulers will be fully enclosed so that material will not be stripped from the vehicle during transport. Before leaving the loading area, the haulers will be inspected for any contaminated material that may have spilled on the exterior of the vehicle during loading. All such material will be removed and that area of the vehicle will be washed down. Wash-down water will be contained and, if necessary, treated with filtrate water from the sludge dewatering process. At the receiving repository, the vehicle will undergo decontamination requirements as established by the receiving facility.

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3.0 TOE DRAIN CLOSURE

The toe drain will be permanently closed when it has been determined that the remaining volume of drainable pore water from the cell will not develop unacceptable hydrostatic pressures within the cell or produce seepage at the cell boundary. In 1994 and 1995 the TAC modeled the drainage, determining it would take 2 to 4 years for the water draining from the tailings to reach equilibration at 7055 ft (2150 m) above MSL. Based on this information, the drain should be closed between 1997 and 1999. A 6-month waiting period after the initial closing of the drain will be needed to confirm that the steady-state phreatic surface of the pore water within the tailings pile is below the elevation of 7055 ft (2150 m). If the phreatic surface rises above this level within the 6-month waiting period or has not achieved a steady-state condition, the drain will be reopened and the drainage/treatment cycle will continue until maximum steady-state conditions are met. To permanently seal the drain after closing the valve, the valve box will be sealed with a bentonite plug and the outlet of the PVC drain into the holding pond will be cut to belowgrade. The outlet pipe then will be packed with bentonite and the end of the pipe will be encased in concrete. The vent pipes at the valve box and at the upper southern end of the drain in the disposal cell slope will be cut to 2 ft (0.6 m) below existing grade; the top of each stem then will be capped and sealed and the surface areas around the vent pipes will be restored to their original conditions.

3.1 DETERMINATION OF TOE DRAIN CLOSURE

When the toe drain is closed, whether permanently or for other reasons (e.g., maintenance, winter shutdown), the data logger results (which are obtained at 6-hour intervals) should be retrieved and examined to determine the water level trend. When the trend shows the water level will remain below the critical elevation of 7055 ft, the toe drain may be left closed and checked again after a 6-month interval. As long as extrapolation of the data continues to show the water level stays below the critical elevation, the toe drain should be left closed and checked at 6-month intervals for a minimum of 2 years. After this 2-year period, the toe drain may be permanently closed as outlined below. Figure A3.6 shows a typical example of the data logger results and how the trend of the phreatic surface has been determined.

3.2 SITE RESTORATION

After all sludge and contaminated materials are removed from the holding pond area of the disposal site, the remaining soil berm of the holding pond will be regraded to permit proper drainage and to minimize the development of high velocity or concentrated flows. The holding pond site receives sheet flow runoff from the northeast face of the disposal cell and will be regraded to allow the sheet flow to drain naturally to the north and east, into the adjacent arroyo and outfall structure of ditch no. 1. Specifications require compacting the fill material to 90 percent Standard Proctor Density (American Society for Testing and Materials [ASTM] D698) (ASTM, 1988).

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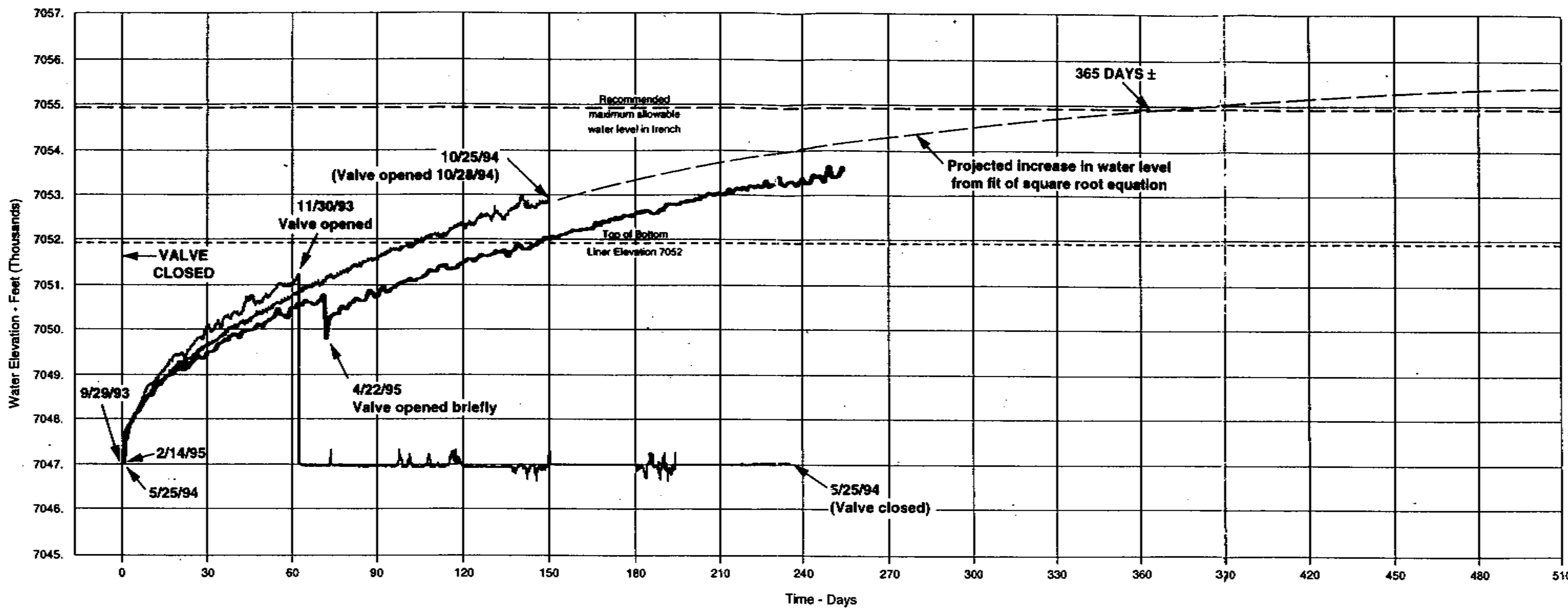

Readings from North Vent Pipe
of Toe Drain

FIGURE A3.6
DURANGO TOE DRAIN
RECHARGE IN TOE DRAIN

When the area is regraded, erosion protection measures will be implemented. Primarily, the disturbed areas will be seeded with a specified hydromulch solution to promote rapid development of a native grass cover. The hydromulch specification will be identical to that used during the remedial action of the disposal cell and processing site. If it is required by engineering calculations, durable riprap will be placed to prevent gullying of outfall drainage from the restored site.

3.3 NRC APPROVAL

The NRC will perform a final site inspection of the restored site. When all issues regarding the restoration are resolved to the satisfaction of the NRC, NRC administrative approval will be recorded and the restored site will fall under the long-term surveillance program of the Bodo Canyon disposal site.

4.0 REFERENCES

ASTM (American Society for Testing and Materials), 1988. *Annual Book of ASTM Standards*, Geotextiles, Standard D 698-78, Method A, "Standard Test Methods for Moisture-Density Relations of Soils and Soil-Aggregate Mixtures Using 4.4-lb (2.49-kg) Rammer and 12-in (305-mm) Drop," Volume 04.08, American Society for Testing Materials, Philadelphia, Pennsylvania.

DOE (U.S. Department of Energy), 1991. *Remedial Action Plan and Site Design for Stabilization of the Inactive Uranium Mill Tailings Site at Durango, Colorado*, UMTRA-DOE/AL-050503.0000, prepared by the U.S. Department of Energy, UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

MK-E (Morrison Knudsen-Engineers, Inc.), 1993. "Durango Seep Water Sludge Analysis," MK-E 3885-DUR-I-01-05094-01, available at the DOE Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

MK-E (Morrison Knudsen-Engineers, Inc.), 1991. "Toe Drain Pond Operation and Decommissioning," MK-E Letter Number 91-3050-B02, available at the DOE Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

TAC (Technical Assistance Contractor), 1992. "TAC Action Memo #378; Results of Sludge Analyses," Jacobs Engineering Group Inc., JEGA/UMT/1192-0637, available at the DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

TAC (Technical Assistance Contractor), 1990. "Modeling of Transient Drainage," Jacobs Engineering Group Inc., Calculation Number DUR-09-90-12-01-00, available at the DOE UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

DOE ORDERS

Order 5820.2A, *Radioactive Waste Management*, 26 September 1988, U.S. Department of Energy, Washington, D.C., UMTRA Project Office, Albuquerque Operations Office, Albuquerque, New Mexico.

CODES OF FEDERAL REGULATIONS

10 CFR Part 40, *Domestic Licensing of Source Material*, U.S. Nuclear Regulatory Commission.

10 CFR Part 61, *Licensing Requirements for Land Disposal of Radioactive Waste*, U.S. Nuclear Regulatory Commission.

40 CFR Part 192, *Health and Environmental Protection Standards for Uranium and Thorium Mill Tailings*, U.S. Environmental Protection Agency.

UNITED STATE CODES

42 USC §6901 *et seq., Resource Conservation and Recovery Act*, 21 October 1976.

42 USC §9601 *et seq., Comprehensive Environmental Response, Compensation, and Liability Act*, 11 December 1990.

TEMPORARY LIST OF REFERENCES AND ACRONYMS – GENERATED ON 11/02/95

ATTACHMENT 4

BODO CANYON TOE DRAIN POND DISCHARGE PERMIT MANAGEMENT PLAN

D. SPECIAL REQUIREMENTS

2. Best Management Practices

Best Management Practices for this facility shall include, but not be limited to, those practices within the control of the permittee and approved by the Division, which are the most effective and practicable means of preventing or reducing the amount of pollution generated by runoff and other sources intercepted and collected for discharge through outfall 004. Management practices shall be followed to ensure that the no discharge design basis is maintained and that any discharges are reduced to minimal impact and minimal frequency. Records pertaining to Best Management Practices should be kept in a log. The continuation of such practices shall include:

a. Daily check of levels in any basins and ponds and operation of any water pump(s), including water level readings in the ponds at least on a weekly basis;

b. Maintain at least a two foot freeboard level in the basins and ponds;

c. Manage water levels in the basins and ponds so that there is an adequate prevention for any potential overflow or bypasses, and to ensure that the maximum degree of treatment is maintained;

d. Maintain facilities in good working condition to ensure a minimal pollution impact into the basins, ponds, and any surface waters;

e. Ensure that no hazardous, toxic, and/or septic waste is allowed to enter the basins and ponds;

f. Daily to weekly inspection of all basins and ponds. Check for dike erosion, rodent holes, and leaks or breaks in dikes and/or liners. Note any damage and perform any needed repairs;

g. Annual weed clearing along the dikes, pond dredging on an as needed basis, and any other good housekeeping practices which are necessary;

h. Maintain compliance with the conditions of the Remedial Action Plan for the facility;

i. Properly operate and manage the facility so that spills are prevented and materials are contained;

j. Ensure that adequate security measures continue to be practiced at the facility;

k. Ensure that the handling, storage and disposal of any toxic and/or hazardous materials on the site is properly being accomplished in compliance with any applicable federal and state requirements;

l. Ensure that materials are compatible with treatment processes, that incompatible materials do not interfere with treatment and storage processes, and that safety, health, and fire hazard prevention measures are practiced;

m. Properly operate and manage the portable wastewater treatment facility at its maximum treatment capability.

These practices may be modified or expanded to include other practices appropriate for pollution control depending on the nature of the effluent streams contributing to the discharge.

ATTACHMENT 5

SITE INSPECTION PHOTO LOG

Page ___ of ___

SITE INSPECTION PHOTO LOG

Site: ______________ Site Activity: ______________________________

Date: ________ Time of Day: From _________ to ______________________

Weather Conditions: ____

Roll Number: ______ Film Type: _______ Number of Exposures ______________

Photo Number	Location (Azimuth[a])	Description

Photographer: ________________________ ________________________

Printed Name Signature

[a]Declination angle: 14.7 degrees east of true north.

ATTACHMENT 6

INITIAL SITE INSPECTION CHECKLIST

INITIAL SITE INSPECTION CHECKLIST FOR THE BODO CANYON DISPOSAL SITE

Date of Last Inspection: ________________ Reason for Last Inspection: ________________

Responsible Agency*: U.S Department of Energy (DOE), Grand Junction Projects Office (GJPO)

Address: P.O. Box 2567, Grand Junction, Colorado 81502-2567

Responsible Agency Official: ________________________________

Inspection Start Date and Time: ________________________________

Weather Conditions at Site: ________________________________

Inspection Completion Date and Time: ________________________________

Chief Inspector: ________________________________
Name Title Organization

Assistant Inspector: ________________________________
Name Title Organization

A. GENERAL INSTRUCTIONS

1. All checklist items must be completed, and detailed comments made, to document the results of the site inspection. The completed checklist will be incorporated as part of the field record of the inspection. Additional pages should be used, as necessary, to ensure that a complete record is made, and should be numbered and attached upon completion of the inspection.

2. Inspectors are to provide an up-to-date résumé or vitae for inclusion in the inspection report.

3. Any checklist line item that is checked by an inspector must be fully explained or an appropriate reference to previous reports provided. The purpose of this requirement is to provide a written explanation of the inspector's observations and rationale for conclusions and recommendations. Explanations are to be placed on additional attachments and cross-referenced appropriately. Explanations, in addition to a narrative, will take the form of sketches, measurements, and annotated site atlas overlays.

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*Responsibility for site inspections assigned by DOE UMTRA Project Office, Albuquerque, to DOE GJPO, November 6, 1990.

4. The site inspection will be a walking inspection of the entire site, including the perimeter and sufficient transects to inspect the entire surface and all features specifically described in this checklist. Every monument, site marker, sign, monitoring well, and settlement plate will be inspected.

5. A set of color print 35-mm photographs is required. Sufficient photographs will be taken to compare to baseline photographs, to determine if there are any significant differences in site appearance. In addition, all anomalous features or new features (such as changes in adjacent area land use) must be photographed. A photo log entry will be made for each photograph taken.

6. Field notes taken to assist in completing this checklist will become part of the inspection record. No form is specified; the field notes must be legible and sufficiently detailed to enable review by succeeding inspectors and the responsible agency.

B. PREPARATION (to be completed prior to site visit)

	Yes	No
1. License (includes long-term surveillance and maintenance plan) reviewed.		
2. Site as-built plans and base map reviewed, with copies of the following site atlas overlays obtained:		
a. Adjacent off-site features and land use; fences, gates, and signs; access roads and paths.		
b. Survey boundary monuments, site markers, settlement plates, aerial photo ground controls, ground photo locations.		
c. Monitor wells, site drainage, diversion channels.		
d. Planned inspection transects and vegetation cover.		
e. Others.		
These overlays will be used to identify site features and record, appropriate field data.		
3. Previous inspection reports reviewed.		
a. Were anomalies or trends in modifying processes detected on previous inspections?		
b. Was a Phase II inspection conducted?		
c. Was custodial maintenance performed?		

Yes No

d. Was contingency repair work done as a result of the Phase II inspection?

4. Site custodial maintenance and contingency repair records reviewed.

   a. Has site contingency repair resulted in a change from as-built conditions?

   b. Are reviewed as-builts available that reflect contingency repair changes?

5. Adjacent property entry approval obtained (attach signed access agreement).

6. Aerial photos reviewed, if taken since last inspection. For each set, enter date taken, scale, and if interpreted.

Set	Date	Scale	Interpreted Yes	Interpreted No
1.	________	________	__	
2.	________	________	__	
3.	________	________	__	

Yes No

7. Were any of the following suggested by examination of aerial photographs (if yes, give photo set date and indicate if item was noted by interpreter or inspector):

   a. Intrusion by man?

   b. Intrusion by animals?

   c. Channelized erosion on slopes?

   d. Change in area drainage?

   e. Landslides?

   f. Creep on slopes?

   g. Obstruction of diversion channels?

	Yes	No
h. Bank erosion of diversion channels?		
i. Seepage?		
j. Cracking?		
k. Change in vegetative cover?		
l. Displacement of fences, site markers, boundary markers, or monuments?		
m. Change in adjacent land use?		
n. Evidence of radioactive sands exposure or transport?		

8. From as-builts or subsequent inspection reports, note distance and azimuth from designated site location, such as a monument, to adjacent off-site features that could eventually affect site integrity.

Off-site feature	Site monument no.	Distance	Azimuth
1. ____________	____________	____________	
2. ____________	____________	____________	
3. ____________	____________	____________	

9. Assemble and check out the following equipment, as needed, to conduct inspections:

   a. Cameras, film, and miscellaneous support equipment.
   b. Binoculars.
   c. Tape measure.
   d. Optical ranging device.
   e. Brunton compass.
   f. Photo scale stick.
   g. Erasable board.
   h. Plant press, plastic bags for vegetation.
   i. Keys to locks.
   j. Bolt cutters.
   k. Hand lens.
   l. Clipboard.
   m. Others.

C. SITE INSPECTION

Yes No

1. Adjacent off-site features (within 0.25 mile [0.4 kilometer] of site boundary)

   a. Have there been any changes in use of adjacent areas (grazing, construction, agriculture)?

   b. Are there any new roads or trails?

   c. Has there been a change in the position of nearby stream channels?

   d. Has there been headward erosion of nearby gullies?

   e. Are there new drainage channels?

   f. Others?

2. Access roads and paths, fences, gates, and signs.

   a. Is there a break in the fence?

   b. Have any posts been damaged or their anchoring weakened?

   c. Is there evidence of erosion or digging beneath the fence?

   d. Does the gate show evidence of tampering or damage?

   e. Is there any evidence of human intrusion?

   f. Is there any evidence of large animal intrusion?

   g. Have any signs been damaged or removed? (Number of signs replaced: ____)

   h. Are access roads and paths passable?

   i. Others?

Yes No

3. Monuments and other permanent features.

   a. Have the survey or boundary monuments been defaced or disturbed?

   b. Have the site markers been disturbed by man or natural processes?

   c. Do natural processes threaten the integrity of any monument or site marker?

   d. Others?

4. Crest.

   a. Is there evidence of uneven settling (depressions, scarps)?

   b. Is there cracking?

   c. Has the outer cover layer been breached?

   d. Is there evidence of erosion?

      1) By water (rills, rivulets)?

      2) By wind (pedestal rocks, ripple marks)?

   e. Is there evidence of animal burrowing?

   f. Others?

5. Slopes.

   a. Is there evidence of gradual downslope movement or creep (terraces, deflection of plants)?

   b. Is there cracking?

   c. Can depressions or bulges on the slope be seen?

   d. Has the outer cover layer been breached?

Yes No

e. Is there evidence of erosion:

1) By water?

2) By wind?

f. Has water runoff become channelized (rivulets, gullies)?

g. Is there evidence of seepage (moisture, color, vegetation)?

h. Is there evidence of animal burrowing?

i. Is there evidence of deterioration of riprap or gravel cover?

j. Others?

6. Periphery (within site boundaries).

a. Is there evidence of seepage, such as wet areas or localized change of vegetation?

b. Is there evidence of sediment transport from the uranium mill tailings by water or wind?

c. Is the vegetative cover as described in the as-builts?

d. Is the drainage as described in the as-builts?

e. Others (burrowing animals, erosion)?

7. Diversion channels.

a. Is there evidence of bank erosion?

b. Has the integrity of riprap structures been disturbed by people or natural processes?

c. Is there evidence of channel erosion?

d. Is there evidence of sedimentation in the channel?

Yes **No**

e. Is the channel obstructed in any way?

f. Is there any evidence that the diversion channels are not performing their function?

g. Others?

8. Photography.

a. Have all photos required by the site atlas photo overlay been taken?

b. Has a photo log sheet been prepared for each roll of film exposed?

c. Number of rolls of film exposed: ____

d. Others?

9. Monitor wells.

a. Have any monitor wells been disturbed by man or natural processes?

b. Does any natural process threaten the integrity of any monitor well?

c. Are all monitor wells capped and locked?

d. Others?

D. FIELD CONCLUSIONS

Yes **No**

1. Is there an imminent hazard to the integrity of the uranium mill tailings (immediate report required)?
   Person: ____________________
   Agency to whom report made: ____________

2. Are more frequent Phase I inspections required?

3. Are existing contingency repair actions satisfactory?

4. Is a Phase II inspection required?

5. Is a contingency report or custodial maintenance required?

	Yes	No
6. Rationale for field conclusions are documented as the text of this report.		

E. CERTIFICATION

I have conducted a prelicensing inspection of the Durango uranium mill tailings site in accordance with the procedures of the license (includes the site-surveillance plan) as recorded on this checklist, attached sheets, field notes, photo log sheets, and photos.

______________________________	______________________________
Chief Inspector's Signature	Printed Name
______________________________	______________________________
Title	Date

ATTACHMENT 7

AGENCY NOTIFICATION AGREEMENTS

U.S. DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL WEATHER SERVICE

Forecast Office
10230 Smith Road
Denver, Colorado 80239

IN UPDC

January 5, 1996

John M. Evett
Project Site Manager
Environmental Restoration Division
Department of Energy
Albuquerque Operations Office
P. O. Box 5400
Albuquerque, New Mexico 87185-5400

Dear Mr. Evett:

Tornado and Flash Flood warning responsibility for La Plata County is assigned to our office at Grand Junction. NWS offices are not staffed to provided post-action notification as you request. Even if we were, the frequencies of tornado events and flash floods in La Plata County are so low that such a procedure would likely be ineffective. For example, between 1950 and 1994, only one tornado has been documented in the county. While flooding is more common than tornadoes, the probability of warning is still small.

With events of such low probability and localized impact, a better point of notification would probably be a local source such as the sheriff, fire department, etc. If this is not feasible, DOE still has meteorological support at the Rocky Flats facility.

I'm sorry that I cannot respond in a positive manner to your request, but I think we would be doing you a disservice to agree to provide support that has little probability of meeting your needs. In case, I've overlooked some option, I'm sending a copy of your letter and this reply to Bob Jacobson, the Meteorologist in Charge of our Grand Junction office. I'm sure he will contact you if he is aware another solution.

Sincerely,

Larry Mooney

Larry Mooney
Meteorologist in Charge
Area Manager, Colorado

cc: R. Jacobson

NOAA

cc:Mail for: jevett

Subject: Durango-Weather Service
From: Joe Virgona 1/22/96 10:34 AM
To: John Evett at UMTRA
cc: Charles Jones

John,

On January 19, 1996 I received a call from Bob Jacobsen, National Weather Service in Grand Junction, (970-243-7007) regarding storm notifications at Durango. He indicated that Larry Moody responded to you in a letter regarding their inability to provide flash flood and tornado warnings directly to DOE. He indicated that the weather service was going "On-Line", and these warnings could be monitored every 8 hours. I advised him I would pass the information on to you.

Joe

John M. Evett
Project Site Manager
Environmental Restoration Division
U.S. Department of Energy
2155 Louisiana Blvd., NE, Ste. 4000
Albuquerque, NM 87110

Dear Mr. Evett:

This letter is to concur with the U.S. Department of Energy (DOE) request for notification as set forth in the DOE's letter. As requested in your letter, this office will contact the DOE's Grand Junction Projects Office at (970) 248-6070 if any unusual event or anomaly is observed or reported at the Bodo Canyon disposal site, Durango, Colorado.

Sincerely,

for Jim Webb
San Juan National Forest Supervisor

John M. Evett
Project Site Manager
Environmental Restoration Division
U.S. Department of Energy
2155 Louisiana Blvd., NE, Ste. 4000
Albuquerque, NM 87110

Dear Mr. Evett:

This letter is to concur with the U.S. Department of Energy (DOE) request for notification as set forth in the DOE's letter. As requested in your letter, this office will contact the DOE's Grand Junction Projects Office at (970) 248-6070 if any unusual event or anomaly is observed or reported at the Bodo Canyon disposal site, Durango, Colorado.

Sincerely,

Duke Schirard
La Plata County Sheriff

National Earthquake Information Center
World Data Center A for Seismology

Director
(303) 236-1510
Research
(303) 236-1506

U.S. Geological Survey
Box 25046, DFC, MS-967
Denver, Colorado 80225 USA
Telex: (WUTCO) 5106014123ESL UD

Operations
(303) 236-1500
QED
(800) 358-2663

Clinton C. Smythe
Engineering and Construction Group Leader
Uranium Mill Tailings Remedial Action
Project Office
2155 Louisiana NE, Suite 4,000
Albuquerque, NM 87110

Dear Mr. Smythe:

This letter is to confirm that the DOE Grand Junction Projects Office (24-hour phone line, (303) 248-6070 has been added to our notification list for the occurrence of earthquakes near the following locations:

Disposal Site	Latitude	Longitude
COLORADO		
Durango (Bodo Canyon)	N37.15	W107.90
Grand Junction	N38.91	W108.32
Gunnison (Landfill)	N38.51	W106.85
Maybell	N40.55	W107.99
Naturita (Dry Flats)	N38.21	W108.60
Rifle (Estes Gulch)	N39.60	W107.82
Slick Rock (Burro Canyon)	N38.05	W108.87
IDAHO		
Lowman	N44.16	W115.61
NEW MEXICO		
Ambrosia Lake	N35.41	W107.80
NORTH DAKOTA		
Bowman	N46.23	W103.55
OREGON		
Lakeview (Collins Ranch)	N42.2	W120.3
PENNSYLVANIA		
Canonsburg	N40.26	W80.25
Burrell VP	N40.62	W79.65
TEXAS		
Falls City	N28.91	W98.13
UTAH		
Mexican Hat	N37.10	W109.85
Salt Lake City (Clive)	N40.69	W113.11

National Earthquake Information Center

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Denver, Colorado 80225 USA
Telex: (WUTCO) 5106014123ESL UD

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QED
(800) 358-2663

We have entered the following selection criteria into our notification program:

1. Any earthquake of magnitude 3.0 or greater, within 0.3 degrees (about 20 miles) of any site shown above, or

2. Any earthquake of magnitude 5.0 or greater, within 1.0 degrees (about 70 miles) of any site shown above.

Sincerely,

Bruce W. Presgrave

Bruce Presgrave
U.S. Geological Survey
National Earthquake Information Center
P.O. Box 25046
Mail Stop 967
Denver Federal Center
Denver, Colorado 80225

Please address future correspondence to Stuart Koyanagi at the above address. I have moved to a different project.

Thank you + best regards,

Bruce Presgrave